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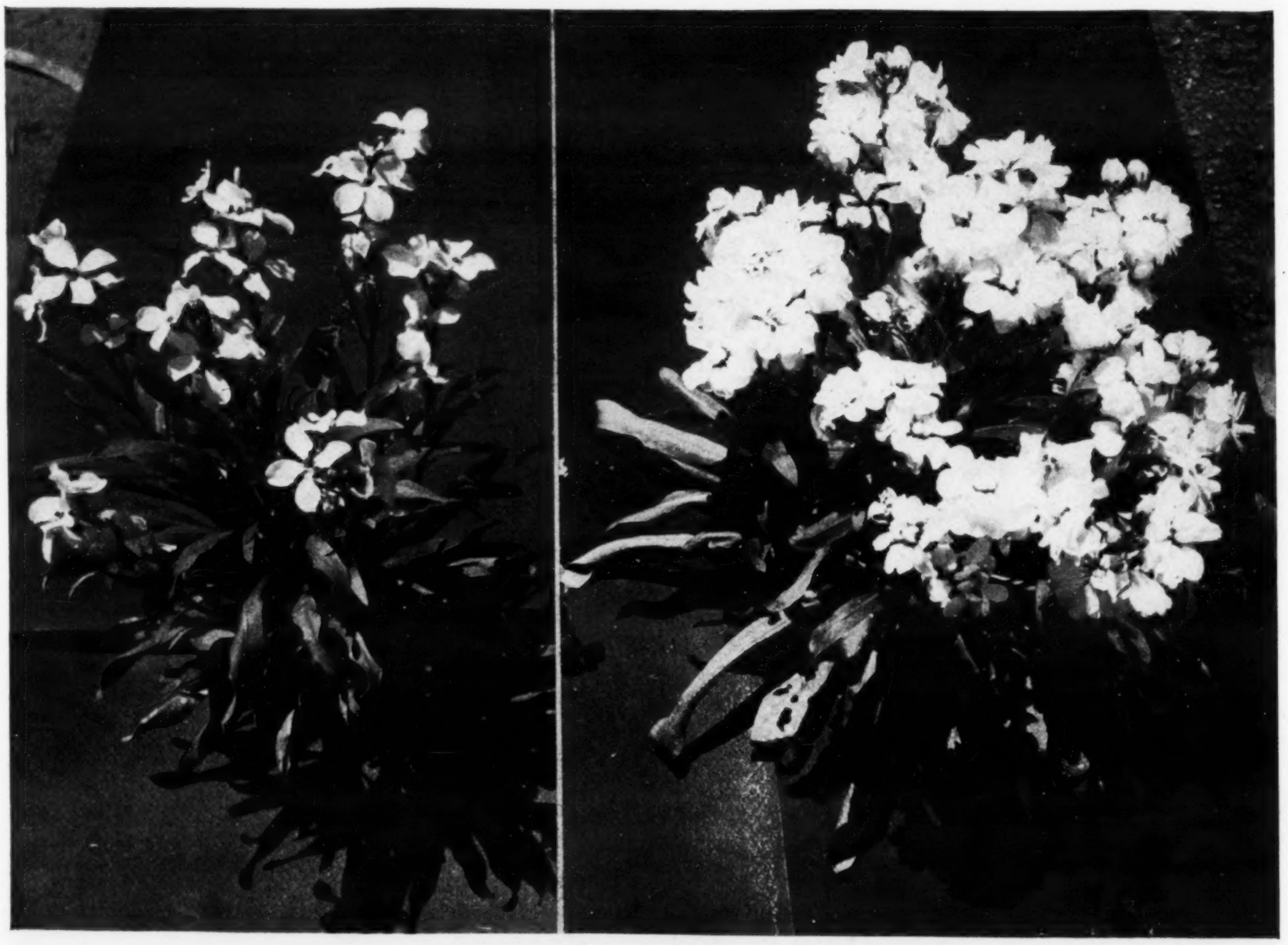
The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics



SINGLE AND DOUBLE STOCKS
(See Page 103)

Will of Edward D. Metcalf

Human Hybrids in Virginia **Thornless Blackberries**

A Tramp Chromosome at Work

MARCH, 1928 Vol. 19, No. 3

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The

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A FLOWER VEGETABLE OF THE SINGALESE

Sesbania (Agati) grandiflora

Frontispiece

Two Singalese girls of Kandy with the morning's pick of large white flowers from the small rapidly-growing trees behind them. These white flowers are sold everywhere on the markets of Ceylon and when properly cooked they form a very delicate constituent of the Ceylon native curry. Small plantations which furnish the markets with this legume are found in Sumatra and Ceylon. The rapid growth of the tree makes it valuable as a shade for other vegetables. There is an attractive pink-flowered variety rather uncommon even in Ceylon.

This is the largest flower-vegetable I have met with in my travels and the most attractive. Should the plant thrive in South Florida it might become a popular and unusual vegetable in the South although I doubt if either its Singalese name of *Katuru-murunga* or its Tamil name of *Agatti-keerai* will.—*David Fairchild.*

WILL OF THE LATE E. D. METCALF

Need to Defend the Bequest for Heredity

AS announced in the February number of the Journal, the American Genetic Association is a beneficiary under the will of Mr. Edward D. Metcalf, who died at Buffalo, Wyoming, December 21, 1927. Members of the A. G. A., whose connection with the Association goes back to 1921, may recall an announcement of a bequest to promote researches in heredity, published in the Journal for November of that year (p. 428). The announcement was incidental to the publication of a remarkable statement that the will contained, of the reasons why provision should be made for extending the knowledge of human heredity. The President of the Association showed the will to Dr. Alexander Graham Bell, inventor of the telephone, who was a life-long student and investigator of heredity, and one of the founders of the American Genetic Association. Dr. Bell was much impressed by the will as an example of remarkably clear insight, high ideals of responsibility, and cogent reasoning from causes to effects in the new field of eugenics where only a few people have been able to think clearly and to practical purpose. It was Dr. Bell who made the suggestion to the Council that the statement of the eugenic clauses of the will be published, if the author would give his permission. The entire will is published in the following pages, as it is in order that the members of the American Genetic Association should be informed as to the nature of this bequest.

The Will Contested

As recognized in the will, under the laws of Wyoming the widow has the right to set aside the will and take half the estate. At the time the will was probated, January 28, 1928, Mrs. Metcalf did so elect, so that, under the terms of the will, the other half of the estate would go to the American Genetic Association. But later a petition was filed to set aside the will on the grounds of undue influence on the part of the American Genetic Association, and of mental incompetency on the part of Mr. Metcalf—as indicated by his interest in the improvement of the race through eugenic measures.

Apparently the decision will hinge on whether a constructive interest in improving the inborn qualities of the race is to be taken as evidence of insanity. The will embodies the ideal of race improvement in a form that shows a remarkable grasp of the vital need for eugenic research. Now a court of law is called on to decide whether this interest in the welfare of his fellow men is to be accepted as an evidence of metal incompetence.

The contest thus becomes more than an attempt to override the lucidly expressed wishes of an individual. It will decide whether this first substantial fund specifically bequeathed for increasing knowledge of heredity is to be withheld for the reason that such an enlightened interest in mankind is evidence of unsound mind. The intention and purpose of the bequest are stated and based on an unusually high-minded philosophy of life and a deep sense of the responsibility and obligation of the individual to the pioneers who have made possible the progress of mankind. Mr. Metcalf realized that the only practical way to repay this debt to those who led the way is not by the erection of useless memorials. Our obligation to the past must be met by dedicating part of our surplus wealth to the pioneers yet to come, that they may have the tools with which to work. He realized that the pioneer of the future must be different from the rancher or the woodsman or the builder of highways. The physical world is won, but if it is to be *held* we must find out how race progress is to be maintained, and how the fatal cycle of the rise and fall of civilization is to be avoided.

More ability and originality are required to see new facts in familiar things and to change commonly accepted ideas than to go out and explore remote countries, or to make telescopes and study the distant stars. There are many would-be discoverers and reformers who are only wrong-minded people, or "cranks" as they are called, often with good intentions but without the ability to see clearly what is needed or to find the way of bringing it about. The men who can contribute new knowledge, insight and progressive example are valued as the true benefactors of the race. But such men may live and die without being understood or appreciated by any of their own friends, neighbors or contemporaries, and some of the greatest have even been persecuted and put to death, though later generations have honored such martyrs to the truth for their firm convictions and fearless testimonies to the facts that they could see while others could not.

The idea and the ideal of eugenics, though recognized by the ancient Greeks, were passed by for many centuries like other "lost arts" of the ancient world that are gradually being appreciated and recovered with the advance of our civilization. Only a few people as yet are sufficiently awake to look out and see clearly from the standpoint of eugenics the profound changes that must occur as soon as the facts of heredity are well understood and appreciated in relation to the many problems of human welfare that depend essentially and eventually upon the character and quality of the race. In a new sense we learn that our life is more than meat and our body is more than raiment. One of the Greek philosophers condensed all his wisdom into a eugenic proverb, "The kind of people that we are determines our destiny." We change ourselves individually but little, but as a people we can look out to the future and see that it is possible to choose what we are to be. It is only as we attain such an outlook that our parental instincts can be fully enlightened and brought into responsible relations with our highest ideals.

When the eugenic doctrines were first put forward by Galton they might well have been looked upon as Utopian—the difficulties seemed too great for any hope of practical value from the study of human heredity. As our knowledge of heredity increased, it gradually has been made plain that we have in heredity the principal factor in the solution of many of the troubles of society. The Metcalf will recognizes the need and the obligation, and would give practical support for this new pioneering enterprise. Thus it is clear that the attack on the sanity of the maker of this will is an attack on the basic principles of this Association.

The regular income of the Association is hardly large enough to meet the expenses of publishing the JOURNAL, and a fund has been raised to meet the immediate expenses connected with the defense. It is too early to know just how large an outlay will be required to defend the will, and later it may be necessary to make a general appeal for contributions to the Metcalf Defense Fund. It would be a disgrace and calamity to have such an enlightened document as the Metcalf will declared the product of an unsound mind.

TEXT OF THE METCALF WILL

LAST WILL AND TESTAMENT

I, Edward D. Metcalf, of Buffalo, Johnson County, Wyoming, being of sound and disposing mind and memory, do hereby make, publish and declare the following to be my last will and testament, to-wit:

FIRST

I hereby revoke any and all former wills and testamentary instruments made by me, and declare this to be my last will.

SECOND

I direct my executors hereinafter named to pay all of my just debts as speedily as possible after my decease from any funds or property of my estate that may be available for the purpose. The principal and only important debt owing by me at the present time is one for ten thousand dollars to my sister, Mrs. Eliza M. Holland, of Northfield, Vermont.

THIRD

I hereby nominate and appoint Wilbur R. Holt and Burt Griggs, of Buffalo, Wyoming, or the survivor of them, executors of this, my last will and testament, and I further nominate and appoint the Wyoming Trust and Savings Bank of Cheyenne, Wyoming, the institution of which Harry B. Henderson is the managing officer at the present time, as trustee to receive my property from said executors and to carry into effect and execution the trusts hereinafter created. So far as may be practicable, I desire my said trustee to confer and counsel with my said executors, even after their discharge.

FOURTH

I hereby give and bequeath to my niece, Mrs. Vera Dimock, of 4527 N. 37th St., Omaha, Nebraska, who, in her widowhood is making a brave fight to support herself and child, the sum of two thousand dollars, to be paid to her by my executors, provided that at the time of my decease she be still unmarried and dependent upon her own efforts for a living.

FIFTH

I hereby give and bequeath unto the American Genetic Association located in the City of Washington, District of Columbia, the sum of ten thousand dollars, to be invested and reinvested by the Council of said Association and the net income therefrom to be used and applied by said council without reservation for the increase and diffusion of knowledge regarding the laws of heredity. In the event, however, that the said American Genetic Association shall cease to exist or to continue engaged in the kind of endeavor for which this fund is bequeathed, the total amount of this bequest shall revert to the Smithsonian Institution located in the District of Columbia to be administered by the Trustees of said Smithsonian Institution in any way it see fit for the increase and diffusion of knowledge regarding the laws of heredity.

SIXTH

I hereby give, devise and bequeath unto my wife, Helen Metcalf, the residence property in the City of Buffalo, Wyoming, now occupied by us as a family residence, together with all of the furniture and personal property therein contained, TO HAVE AND TO HOLD the same unto her sole and separate use and enjoyment forever.

SEVENTH

All of the rest, residue and remainder of my property, real and personal, and wheresoever situate, I give, devise and bequeath unto my TRUSTEE aforesaid, in TRUST, to carry out the provisions of this, my last will and testament according to my desires and wishes as hereinafter contained.

I direct that my real estate, and

such other of my property as may not now be of the character hereafter described, shall be disposed of as rapidly as my trustee may be able to realize a fair price therefor, and the proceeds therefrom invested in securities or loans as hereinafter provited. All of my property of every nature will be found listed under appropriate headings in my ledger, with the approximate values, usually cost prices, after each and every item. The sum realized from the sales of such property I desire invested in first class securities like Municipal, Industrial and Government bonds, and not to exceed one-tenth of my entire net estate in any single security or investment. A limited amount, say twenty per cent of the whole, may be invested in first class real estate loans in Johnson County, Wyoming, at the discretion of my trustee. In order more effectually to carry out the above provisions, I hereby authorize the sale of any property of my estate, by my trustee, without any previous order of court of appraisement therefor.

EIGHTH

The fund created by the last paragraph of this will is to be devoted and used for beneficial purposes only, my wife and family and those coming after them to have the preference right thereto, but never under any circumstances is such fund to be used wastefully or extravagantly or under such circumstances as to encourage idle or luxurious living. This property represents the savings of a lifetime of industry, economy and self-denial, and I wish it to be used wisely and made to count for individual and race betterment.

I direct that the sum of twenty-five hundred dollars per annum be paid over to my wife, for the support of herself and children, so long as she remains unmarried. Said payments shall be made to her in cash quarter annually. Should she remarry, I direct that the annuity to her be reduced to the sum of twelve hundred dollars, likewise payable quarterly, for the remainder of her natural life.

As soon as my son is old enough for college, I desire that he be provided with the sum of $1,200.00 per annum for his use during his college course, to meet his necessary expenses and to enable him to pursue his studies, but not to enable him to indulge in extravagancies or luxuries, should he happen to be so inclined. I hope that my son will marry early, say not later than the age of twenty-five, and trust that he will marry advisedly and know that his chosen mate came from a family in which useful and capable men and women predominate. To assist and encourage him in his chosen pursuit or profession, I direct my trustee to pay to him at the time of his marriage the sum of five thousand dollars. I also direct that for each and every child born to him before the termination of the trust created by this will, he be paid the sum of twenty-five hundred dollars as soon as each such child shall have attained the age of three years. Should my said son develop scholarly tastes and desire to devote his life to the pursuit of science and the acquisition of knowledge (and particularly along the lines of Biology and Genetics) and manifest a degree of ability along those lines, (which might best be judged and determined by his original essays and papers appearing in scientific publications or by lectures before scientific bodies), then and in that case I desire that he have all of the money that he may need and use to advantage in the pursuit of the studies and researches, even to the limit of the income not otherwise appropriated. Should he desire to follow some business vocation in which capital is required, like agriculture, horticulture, live stock, mercantile or manufacturing pursuits, and manifest an ability in that direction, I desire that he be paid the sum of ten thousand dollars out of the income or principal of said trust fund when he shall have attained the age

of thirty years, and, if he make progress in such pursuit or calling (my trustee to be the judge as to that) he shall receive ten thousand dollars additional when he shall have attained the age of forty years. If I shall have others sons who shall reach maturity, I desire that he or they shall receive the same benefits and that the same provisions shall apply to each of them as are above provided for my present son.

As to my daughter and any future daughters born to me, I desire that she or they shall have the advantage of a higher or college education, if such education be of a practical or beneficial kind, but I do not favor a smattering of music and art and the so-called accomplishments which often carry with them conceits, vanities and follies which later have to be unlearned at bitter cost. Neither do I want their minds taxed with the study of abstruse branches of learning which are of but little use and sometimes result in shattered nerves and weakened womanhood which lessens the possibility of happy and useful lives. I desire that they be taught the laws of health and beauty and how to preserve them; and also something of the laws of heredity. I desire also that they be taught that as this world was created for the evolution and development of man, their supreme duty and greatest glory consists in rearing of a family of noble sons and daughters; that the more nearly perfect they are themselves the greater the obligation which rests upon them in this respect. When it is remembered that college girls are frequently failures as wives and mothers; that recent statistics go to show that they average less than one child each, it will be seen that I have good and sufficient reasons for not wanting to devote money to the conventional "higher education" of women. A college education is a failure and race deterioration a certainty when the daughters of the best families in the land fail in parentage. If my daughters desire the practical kind of education indicated, and there be an institution where such branches are taught my trustee is instructed to supply the means, otherwise nothing is to be expended for "higher education." At the time of marriage my trustee is instructed to pay to my daughter or daughters the same amount as provided for my son, and for each child born to her she is to receive the same sum to be paid according to the same conditions as above provided for my son.

NINTH

At the end of fifty years after my death I desire that the trust aforesaid be ended and my estate closed, and that all of the residue of trust fund or estate be divided, one fourth to any sons and daughters of mine then living, to share said one-fourth collectively and equally; one-fourth to my grandchildren then living to share the same collectively and equally, providing that if there be no grandchildren of mine then living the one-fourth above given to them shall go to any sons and daughters of mine then living; and the remaining one half of my estate I give, devise and bequeath unto the American Genetic Association of Washington, D. C., for the same uses and purposes as are expressed in paragraph Fifth of this will, and I hereby name the said American Genetic Association of Washington, D. C. as the residuary legatee of all of my estate.

TENTH

In preparing this will I have given first consideration to the support of my wife and family, making the amount what I consider ample and making it a first lien on the income of the estate. I have made additional provision for the education of the children, and finally, in case my children, or any that may follow should happen to have a taste for learning and the pursuit of science, I have made additional provision for his support and assistance to the

end that he may pursue his studies unhampered by the necessity of earning his living in ordinary though perhaps more productive pursuits. In other words, I have made what I consider the best and wisest provision possible and in order that my wife may not be tempted or influenced to disregard the terms of the will and exercise her right of election, under the Statute, as it now stands in the State of Wyoming, I do hereby provide and order that should she so elect to set aside this will, then and in the case she must make the half of the estate so chosen and allowed to her by the Statute, do for not only her own support but that of the children as well, and I will rely upon her natural affections to deal justly and equitably by them, the other half of my estate in that case to go in its entirely to the American Genetic Association for the uses and purposes as above specified. I know of no cause more useful and worthy than the cause of science and particularly that part of it which applies to race betterment and the improvement of humanity.

In order to make myself better understood in this my last will and testament I desire first to explain that for many years I have held to the belief that wealth, especially great wealth, in the hands of any party should be regarded to some extent as a sacred trust for it has cost the life and labor of some one, perhaps of many, to produce it. While a man has a legal right to do as he pleases with what is his own, he does not always have the moral right to do so. Money or property wisely employed benefits the entire community, as well as the individual owner; unwisely employed it becomes a detriment to the community, and when devoted to idleness and luxury, or squandered in fast and riotous living it becomes a curse to the one who possesses it. This is so well understood by many that it has been well said that probably the worst thing that could happen to the majority of mankind would be inherit wealth and to be relieved of the necessity of earning a living. Accumulated wealth in its power for good or evil might be compared to water gathered together in a storage reservoir; it can be made to turn the wheels of industry or irrigate a valley or do both at the same time, but uncontrolled and unguided it becomes a power for destruction, and out of its proper channel it soon becomes a torrent of mud, polluting and destroying everything in its path.

Another thought which has possessed my mind for a long time is that every man should contribute something of his savings to some worthy cause, for it is only by so doing that we can repay the debt we owe to those sturdy pioneers of progress who by their unselfish efforts have, in all countries and ages, helped to make civilization possible. This thought has been confirmed and strengthened by the conviction, strong in my mind, that this world with its vast resources and powers, must have been created for a purpose, and that purpose must have been the evolution and development of man.

The idea that the forces and powers of nature, chemical, mechanical and electrical and all of the vast supplies of coal, oil and minerals, were here to remain forever unused and unapplied, is to my mind unthinkable and as inconceivable as the idea of a great factory, equipped with modern machinery, being located in an uninhabited country.

Man, then, being the object and purpose of creation, it becomes our duty to co-operate with nature in hastening the day of his perfection, for man is a creature of evolution, and still an unfinished product. To be as brief as possible, I am now convinced from some study and much thought, that it is only by a greater knowledge and application of the laws of life and growth that man can hope to hasten his progress up-

ward toward that happy day when weakness and sin will be reduced to a minimum and when the least efficient of mankind will be the equal of the greatest of today. Religion alone can never work this change, for polish and refine a man as you will, the work has all to be done over again with his son, for polish is not hereditary any more than the clothes a man wears. Religion at its best is but a crutch to help men walk, to aid the weak and wayward through this life.

What the world needs is a race of men who are neither crippled in body or mind; for when men are born right, they will have no need to be "Born again." Religion can help us to lofty ideals but we must look to science to point the way to a realization of those ideals. Science has achieved wonders in the development of plants and animals, and it is high time now to turn attention to man himself, for he is subject to the same laws of life and growth. For thousands of years nature has been separating the sheep from the goats in her own harsh way. Under primitive conditions the weakest and least alert in body and mind were the first to fall, and progress was rapid. But nature is still on the job and while man today is no longer surrounded by wild beasts and savage foes with whom he has to battle with bare fists, yet he is surrounded with even more destructive and insidious foes in the form of temptations to excesses and indulgencies in hundreds of ways.

We have all observed how quickly the savage races have fallen when suddenly exposed to the vices and temptations of civilization, and civilized man has by no means acquired immunity. In prehistoric times certain men and families were eliminated on account of their physical weaknesses and imperfections; now they are being eliminated for their vices and immoralities. Man-killing monsters did the work then; fool-killing vices do the work now.

Under the earlier conditions man was refined physically; under the latter conditions he is being refined and perfected morally, for the man of the future must be strong in will power; the power of self direction and self control. The present age is perhaps the most critical and trying in man's career; it is a time when instinct is loosing its hold and intelligence and will are not yet sufficiently developed to be a safe guide. As a race our present position might well be compared to that of the young man just out of college. Parents and teachers have done their part and his future success will depend largely upon his own efforts.

As a race we have been reared in the lap of nature like other creatures, but the time has now arrived when our destiny is largely in our own hands and we must co-operate with all our strength to eliminate weakness and develop the "High minded man, with powers as far above dull brutes endued as brutes excel cold rocks and brambles rude." Race betterment is the all-important work toward which our resources and energies should be directed and all other matters are significant only, or mainly, as they contribue to this grand purpose.

I trust this brief philosophy of life will make me better understood by those who have known me and make my meaning clear in the foregoing disposition of my property.

EXECUTED BY THE TESTATOR as his last will and testament, at the City of Buffalo, Wyoming, this December 3, 1921, in the presence of the subscribing witnesses.

PROGENY OF A SLENDER STOCK PLANT

Figure 1

In these 54 paper pots, 54 seeds were sown. The 48 progeny consisted of normals and Slenders, with two small plants of other trisomic types. Elimination of these two small plants, and of all plants classed as Slender, leaves 23 or 24 normal plants, of which 78 or 79 per cent proved to be double. In the left rows of pots (numbering the nine pots in each row from front to back), the plants classed as normal are those in pots 3, 7, 8, 10 (single), 13 and 18 (single). The size differences among the plants were doubtless reduced by the paper pots, which prevent root competition between adjacent plants.

CHROMOSOME-MUTANT TYPES IN STOCKS

II. Putting a Tramp Chromosome to Work*

HOWARD B. FROST
University of California

DOUBLE-FLOWERED stocks (*Matthiola incana* R. Br.) are completely sterile, having no stamens or pistils in their flowers. They are, therefore, grown solely from seed of single-flowered plants that are heterozygous for the recessive double character.

As de Vries[9] has stated, doubleness in stocks is of the kind known as *petalomany;* the axis of the flower is proliferous, and bears an indefinite number of petals. The resulting mass of petals makes the double flower much more showy than the single flower (Figure 2), and stocks are therefore grown mainly for the double-flowered plants.

Some varieties of stocks are homozygous (pure) for singleness, and therefore produce only single flowers. In other varieties, called "double-throwing" by Miss Edith R. Saunders, the single-flowered plants are all heterozygous for doubleness, and a little more than 50 per cent of their progeny, on the average, have double flowers.[4] In such double-throwers the pollen transmits only doubleness, while the eggs transmit both singleness and doubleness.[4] Self-pollination of a double-thrower is, therefore, similar in its results to an ordinary back cross of a heterozygote to a pure recessive, which typically gives about 50 per cent of recessive progeny.

The absence of singleness from the functional double-thrower pollen is presumably due to a pollen-lethal gene (or genes).[1] For the present purpose, with the qualification stated below, we may represent the doubles by *dd* and the double-thrower singles by *Dd*. Self-pollination of the latter then gives $D \times d = Dd$ (single) and $d \times d = dd$ (double), the double progeny being usually about 53 to 56 per cent of the total. For the excess of doubles over 50 per cent, several explanations ([1, 4, 6, 8]) have been proposed. Miss Saunders' hypothesis, based on her extensive study of the inheritance of doubleness in Matthiola, assumes that the double-thrower singles are heterozygous for *two* genes for singleness (*X* and *Y*), which are complementary and closely linked. On this view, singles are *XYxy* and their (functional) pollen is all *xy;* doubles are mostly *xyxy*, sometimes *Xyxy* or *xYxy*. A difference in zygotic viability between singles and doubles seems to have some effect on the average ratio ([1, 4, 5]), but does not seem to be the sole cause of the excess of doubles over 50 per cent [6, 8].

Various procedures have been practiced by growers and users of stock seed, in the hope of increasing the percentage of the more showy double-flowered plants. Miss Saunders [5] concludes that the single or double character is strictly determined in the seed, but that the proportion of doubles actually grown to flowering can be somewhat increased by discarding the smaller and weaker plants among the young seedlings. The singles average somewhat smaller than the doubles, and therefore more singles than doubles will be discarded. There is also some reason to expect [4, 9] that seed which gives poor germination because of old age or poor ripening will give a higher percentage of double plants, but obviously the use of poor seed does not furnish a satisfactory method of increasing the percentage of doubles. It is, of course, necessary to prevent pollination of parent double-thrower plants by pure singles; if this

*Paper No. 166, University of California, Graduate School of Tropical Agriculture and Citrus Experiment Station, Riverside, California.

SINGLE AND DOUBLE STOCKS

Figure 2

At left, a normal Snowflake plant with single flowers; at right, one with double flowers. The extra chromosome of the Slender trisomic (Figure 1) evidently carries the locus of the genes which determine whether the flowers are single or double.

occurs the resulting F_1 hybrids will all be singles, while part of these hybrids will produce no double F_2 progeny, and the rest will give only about 25 per cent of doubles, or even less [4]. Miss Saunders [4] finds that commercial varieties supposed to give doubles are often mixed with pure singles.

The Tramp Chromosome in the Flower Garden

One of the trisomic (extra-chromosome) forms of stock described in Paper I of this series [2] gives promise of horticultural usefulness as a high-double race. The Slender trisomic derived from the double-thrower variety "Snowflake" has given (Table I), when selfed, a considerably higher proportion of double progeny than has normal Snowflake. This fact by itself seems to be of no practical importance, since about one-third of the progeny commonly belong to the weak Slender type. The horticultural possibilities of the form depend on two further characteristics. One of these is the possibility of recognizing and discarding most of the Slenders among the young seedlings; the other is the fact (Table I) that *most of the normal progeny of Slender parents are doubles.* Therefore, if the smaller plants, and especially the plants with narrow, long-petioled leaves, are discarded, the rest should be mostly doubles. Since Miss Saunders has shown [5] that elimination of the smaller seedlings of normal parents may markedly increase the percentage of doubles grown to flowering, it should be easy to get very high percentages from Slender parents.

Miss Saunders[5] shows, from her

special tests and from the experience of a gardener, that the proportion of doubles *among the largest seedlings* produced by a sowing of a double-throwing variety may be as high as 75 to 85 per cent, although the complete sowing is likely to show only about 55 per cent of doubles. As de Vries[9] indicates, there are some slight morphological differences between singles and doubles as young seedings, and it is doubtless possible for a skilled operator to eliminate the singles more thoroughly than can be done by consideration of size or vigor alone. Mr. E. L. Koethen, of Riverside, California, states that he used to select stocks so as to eliminate most of the singles. He considered both size of plant and size and shape of leaves, and found that satisfactory use of leaf shape depended on acquaintance with the characters of the particular strain employed. Whatever the skill and care applied in the selection, the results should be better when seed from Slender parents is employed, since the great majority of the singles are then conspicuously "labeled" by their slender growth. Figure 1 shows progeny of a Slender parent.*

The percentages of doubles given by Slender, both when selfed and when crossed with normal, are shown in Table I. Larger numbers from selfing, not yet tabulated, show similar ratios. The ratios agree in general trend with the theoretical ratios for random trisomic segregation, if we assume that all Slender parents tested have carried only one singleness gene (formula *Ddd*), or one *XY* set of genes. Probably *DDd* (or *XYXYxy*) plants, like *D* (or *XY*) pollen, are unable to survive.

There is cytological evidence [3 †] which indicates that chromosome reduction is not random in the trisome group of Slender. This fact, together with the peculiar circumstances connected with the disomic inheritance of doubleness [4, 1], probably accounts for certain marked deviations from the calculated ratios. Miss Saunders' formula gives more numerous theoretical possibilities than does the simpler formula mentioned, but on neither scheme, if one assumes random trisomic segregation, do the calculated ratios correspond well with those observed. Fortunately for the horticultural possibilities of the Slender form, the percentage of doubles among its normal progeny is very high (Table I).

Successful horticultural utilization of the Slender form seems to be a matter of popular psychology. If enough growers of stocks would care to fol-

*For comparable progeny of a normal parent, see Figure 2 in paper I of this heries.[2]

†See also the discussion of Slender and Crenate in paper I of this series.[2]

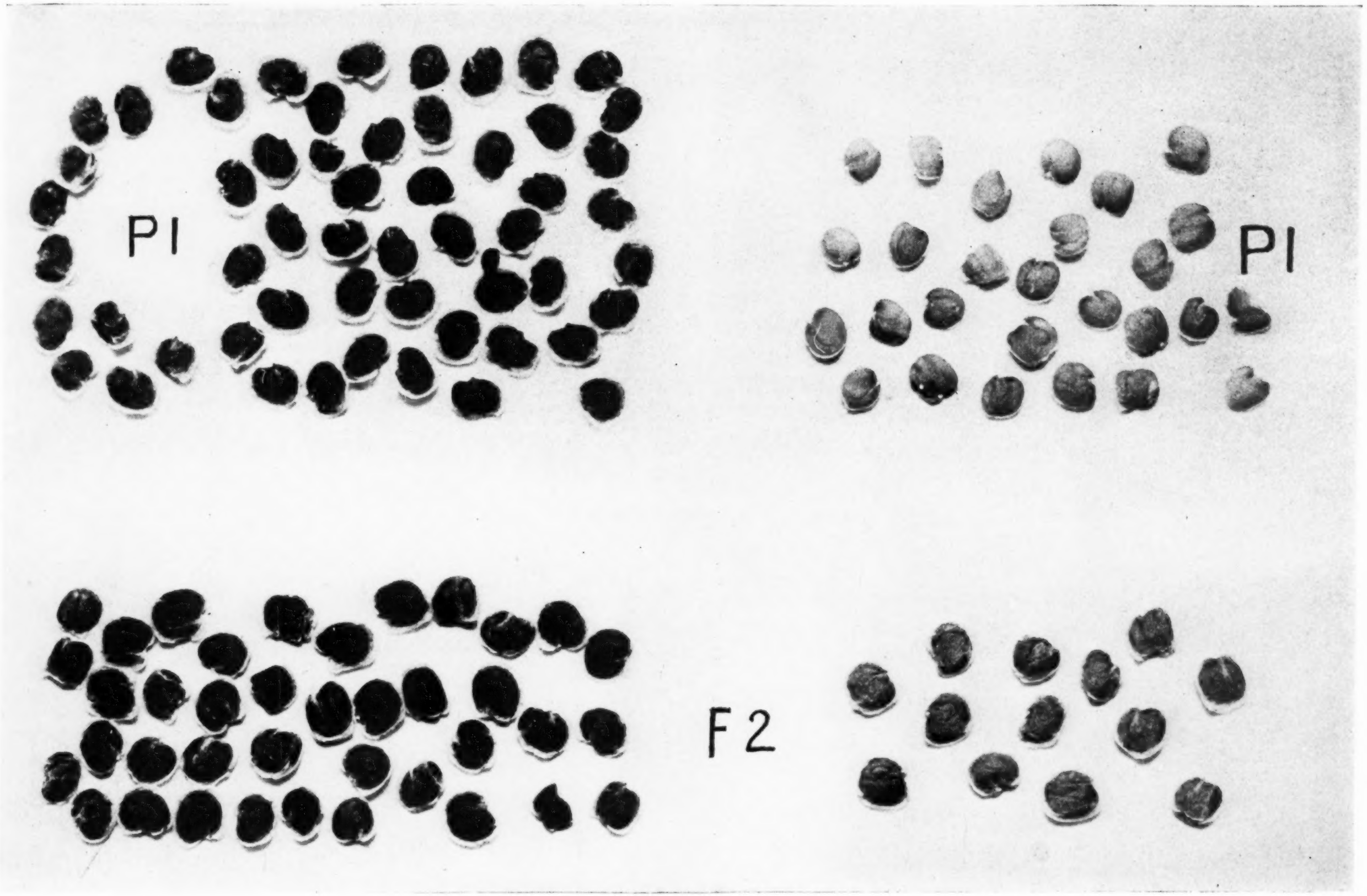
TABLE I—Progeny of Slender Parents (a)

Parentage	Slender		Normal (b)			All Slender	All normal (b)	Per cent Slender	All single	All double	Per cent double (c)
	Single	Double	Single	Double	Per cent double						
Slender selfed	140	56	42	289	87.3±1.9	207	339	37.9±1.4	182	346	65.5±1.5
Slender normal	56	21	22	137	86.2±2.7	78	159	32.9±2.1	78	158	66.9±2.2
Normal Slender	48	17	128	170	57.0±2.0	66	301	18.0±1.4	176	188	51.6±1.8

(a) The slight discrepancies in the totals are due to a few plants that were determined for doubleness or for trisomic character but not for both.

(b) All plants not Slender, including a few miscellaneous mutants, are here classed as "normal."

(c) Doubles constituted 52.90 ± .42 per cent of 6276 progeny of normal (Snowflake) parents grown at Ithaca, New York. This percentage has been used p in calculating the probable error of the percentage of doubles in this table from $\text{S.D.}_{\%} = \sqrt{\frac{pq}{n}}$



SEGREGATION OF SEED (EMBRYO) COLOR

Figure 3

Above, left: black seeds, from one capsule of "Series 38" a race with purple flowers; right, orange seeds (no sap color; dull yellow orange, near Ridgeway's 15," cinnamon), from one capsule of Snowflake, a race with white flowers. Below: the seeds (F_2 embryo) from one capsule of an F_1 hybrid between Snowflake and series 38; left, 39 black seeds; right, 13 orange seeds (dull orange-yellow orange; near Ridgeway's 13," Orange Cinnamon); ratio, 3 sap-colored: 1 non-sap-colored. The black seeds will produce plants with purple flowers; the orange seeds, plants with white flowers. (About 1 5/6 times natural size.)

low simple directions printed on the seed packet as to the needed rejection of small and narrow-leaved seedlings, the use of Slender as a high-double type could evidently be made very successful. The seed must, of course, be grown, in each generation, from Slender parents only, the normal singles being discarded. Slender forms with colored flowers could readily be produced by crossing with ordinary colored double-throwers. There would be no more danger of deterioration through crossing and mixing with pure single forms than now prevails in the case of ordinary double-throwing varieties. There would be no need of guarded pollination within a Slender double-throwing race, for pollination of Slender by normal gives about the same percentage of doubles as does selfing of Slender (Table I).

The seeds may be sown broadcast in pans or flats, the crowded seedlings selected for vigor at the first transplanting, and all small or narrow-leaved plants discarded at the final transplanting. Most of the Slenders can be recognized easily when the plants have several well developed leaves each.

The Tramp Chromosome in the Laboratory

In relation to the teaching of genetics, also, these forms give promise of usefulness. In some respects the Matthiola trisomics seem better suited to this use than the Datura trisomics. The plants require less space and produce much larger numbers of buds. The number of known genes is much larger in the case of Matthiola, although aside from the case of doubleness little is yet known of their behavior in trisomic forms. So far there has been found in Matthiola no case of uncomplicated trisomic inheritance, like that of purple in the Poinsettia trisomic of Datura.* In spite of the aberrant ratios, however, the Slender trisomic of double-thrower Matthiola has a special claim to consideration. Crenate, which gives similar ratios for doubleness, may also be used.

In an uncomplicated case of trisomic inheritance, at least two stock strains of known composition are needed for the production of illustrative material, and repeated crossing is necessary. Or, if hybrids of later generations than F_1 are used as parents, they must be individually tested to identify those of the desired composition. With these two forms of Matthiola, all that is needed for illustration of trisomic inheritance of doubleness is continued selfing of normals and trisomics within one stock strain. The flowers need not be guarded for selfing, since the ratios are practically unaffected by the amount of vicinism that occurs. The progeny of all normal parents illustrate one of the widely known cases of aberrant disomic ratios, and all trisomic parents give the corresponding trisomic ratio. Both Slender and Crenate are readily recognized, as a rule, even as young seedlings. Slender is considerably the more vigorous and fertile; Crenate often fails to set seed unless the climatic conditions are decidedly favorable.

If a Datura form is to be used to illustrate uncomplicated trisomic inheritance, Slender Matthiola can be added with very little labor and will furnish a very interesting contrast in both genetic and cytological behavior. If normal Matthiola hybrids are to be used to illustrate the disomic inheritance of seed color, the P_1 plants may be a Slender double-thrower and a normal double-thrower, thus providing at the same time material to illustrate the trisomic inheritance of doubleness.

Geneticists who have worked on

*Since this paragraph was written, it has been almost certainly established that the Narrow trisomic of Matthiola gives trisomic ratios for the purple-vs.-red genes, *Bb*. Narrow plants heterozygous for purple have given about 8 purple: 1 red among their normal progeny, instead of the usual 3:1 ratio, suggesting random trisomic segregation in *BBb* parents. Narrow is, however, a late-flowering trisomic of relatively low fertility.

seeds (F_2 embryo) from one capsule of an F_1 hybrid between Snowflake and series 38; left, 6; black seeds 3; seeds (dull orange-yellow orange; near Ridgeway's 13," Orange Cinnamon); ratio, 3 sap-colored: 1 non-sap-colored. The black seeds will produce plants with purple flowers; the orange seeds, plants with white flowers. (About 1 5/6 times natural size.)

Matthiola have noted certain correspondences between corolla color and seed (embryo) color. Varieties with recessive white flower color lack sap color in the seeds also; their seeds are usually of a dull yellowish orange color. On the other hand, varieties with sap-colored flowers commonly have sap color in the embryos. Since the Matthiola corolla shows a much larger number of distinguishable colors than does the embryo, genetic studies of sap color have dealt mainly with the flowers. Embryo color has one obvious advantage, however, in that the determination is made in the seed stage.

Seed Color for Genetics Teaching

Matthiola seed color gives promise of usefulness in the teaching of genetics. As the embryo color is visible through the seed coats, capsules of F_1 hybrids can be used to illustrate monohybrid and dihybrid segregation, and ratios for considerable numbers of F_2 embryos are readily obtained. The material has one great advantage over maize seeds, in that embryos are employed, instead of triploid endosperm tissue. One disadvantage is the much greater difficulty of obtaining F_1 seeds in quantity. However if a yellow-seeded parent is pollinated by a dark-seeded, shortly before the time of normal opening of the corolla, little care is necessary in manipulation, since any yellow seeds can readily be discarded. Further disadvantages in comparison with maize are the ready shattering of the pods and the need of special treatment if material is to be examined more than once. The much greater number of seeds per pod and per plant is an advantage over pea material. In length of growth period, both maize and peas have a marked advantage.

For full development of the colors, the seeds must be well developed and matured. With our hybrids it seems to be difficult to secure material that permits completely accurate dihybrid classification, but a monohybrid cross between black (purple sap color) and orange (no sap color) gives very good contrast. A long growing season is needed, since the development of the seeds requires about three to four months after pollination. A few plants in eight-inch pots in a cool greenhouse should furnish a considerable amount of material, and under some conditions such plants can even be kept alive for two years or more.

A monohybrid cross involving one of the genes for presence of sap color, evidently Miss Saunders' *C* or *R*,[7] is illustrated in Figure 3. Our seed-color dihybrids have been produced by crossing Snowflake (flowers white; seeds yellowish orange) with red-flowered races having brown seeds; since Snowflake carries the purpling gene *B*, the F_1 plants have purple flowers, and the seeds in their capsules (with F_2 embryos) are black or blackish, brown and yellowish orange, the ratio approximating 9 : 3 : 4. The black seeds produce F_2 plants with purple flowers, the brown seeds give red flowers, and the orange seeds give white flowers. If the seeds on these F_1 dihybrids are not well ripened, accurate classification becomes difficult or impossible. Even with well colored seeds, occasional errors in classification have occurred, apparently for a very curious reason. There seems to be a general tendency for brown seeds borne on heterozygous purple-flowered plants (*Bb*) to be darker than those borne on red plants (*bb*), and somewhat frequently hybrid seeds classed without question as black have produced red-flowered F_2 plants. Since the purpling gene *B* presumably affects the color by changing the reaction of the cell sap in the direction of alkalinity, it seems likely that genetically red (*bb*) embryos on hybrid purple (*Bb*) plants often undergo some modification of their reaction toward that of the surrounding maternal tissues (the seed coats and the funiculus).

Material for illustration of segregation can readily be obtained from plants of F_2 and later generations, since the heterozygous plants can be identified

by inspection of a few of their seeds.

Small quantities of seed can be furnished to teachers of genetics for the purposes mentioned. Seed is available from "Snowflake" (white-flowered double-thrower) Slender parents, and also from F_1 hybrids between Snowflake and pure single races with colored flowers and seeds. The available hybrid parents include diploids and several kinds of trisomics (Large, Slender and Smooth, at least). No *colored* double-throwers have yet been used in crossing.

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Waxy Endosperm in Argentine Maize

SINCE waxy endosperm has been previously reported from China, Burma, the Philippines, and Connecticut, it may be of interest to call attention to the fact that a new locality for its appearance has been discovered.

In 1926, while examining several thousand ears of corn for another purpose at Presidencia Roque Pena, in the Argentine Chaco, one was found that appeared to be segregating for waxy. Tests with iodine potassium-iodide solution gave the characteristic reddish color. F_1 seeds from crosses made at Ithaca during the past summer (1927) between Argentine waxy and cultures derived from the Chinese waxy of Collins gave the same reaction. Four non-waxy sibs in a total of six were segregating for waxy.

The variety in which it was found is known as Cuarenton, an orange-yellow crystalline flint, with which the duller yellow of the waxy seeds make a conspicuous contrast on thoroughly ripened field cured ears. Whether this Argentine waxy originated by mutation or was brought to South America from China *via* Italy and Asia Minor, is a matter for speculation. *Thomas Bregger.*

PROPAGATION OF KIEFFER PEAR ORCHARDS

Figure 4

Two Kieffer Pear Orchards at Kinderhook, N. Y., one (above) on French roots and the other on its own roots. The vigor and uniformity of the trees on their own roots is in striking contrast to the grafted trees, some of which are dead.

THE IMPORTANCE OF STOCKS IN KIEFFER PEAR GROWING

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A PRACTICAL instance of the important part that stocks may be playing in Kieffer pear growing without receiving much consideration is brought to attention by an unusually successful orchard of this variety growing on an unfertile, coarse sandy loam, at Kinderhook, New York, twenty miles south of Albany in the Hudson River Valley.

The owner, Mr. L. L. Morrell, is widely known in fruit circles for the remarkable uniformity and vigor of his trees and the almost yearly successful crops, quite in contrast to neighboring orchards which are rapidly being removed as unprofitable. Figures will show that this orchard of the generally despised Kieffer has brought greater net returns than any other block of trees on the farm, including several varieties of pears, apples, and sour cherries. The success of the enterprise is due in large part, of course, to the ability and enterprise of Mr. Morrell, yet he has always claimed that the great difference between his orchard and others in the neighborhood is in the roots upon which the trees are growing and not to any unusual cultural treatment on his part.

Until recently practically all pears in America have been either budded or grafted upon imported French seedlings of the common European pear (*Pyrus communis*) from which all but a very few of the several thousand pear varieties in the world have sprung and are familiar to all in such varieties as Bartlett, Bosc, Anjou, Seckel, and Winter Nelis. There are few exceptions to the general rule that commercial pear orchards in the northeastern United States are on so-called "French roots" in contrast to roots of other species. Kieffer orchards have been no exception in this respect excepting in Georgia and nearby Southern States where this variety roots readily from cuttings. Varieties of the European pear do not root from cuttings, and Kieffer is propagated commerically from cuttings only where already mentioned and there to small extent.

Kieffer is a hybrid pear, a cross between the common pear (*Pyrus communis*) and the Chinese Sand Pear (*Pyrus serotina*), and like others of its class it has more in common with its Oriental relatives than its European ones. That is, it is less subject to blight, more vigorous, adapted to hotter regions, and tolerant of more droughty conditions. The European pears reflect their northern French and Belgian origin by preferring a cool climate. Accordingly Kieffer and its related kinds are of value in extending the range of pear growing into southern latitudes and onto lighter soils.

The trees in question were received from a New Jersey nurseryman, a relative of the owner of the orchard, who secured the wood from which the trees were propagated by personally visiting Mr. Peter Kieffer at Roxborough, Pennsylvania, the originator of the Kieffer pear. When refused the sale of the original tree, he purchased ten dollars worth of wood, sent it to Georgia to be propagated as cuttings, and the resulting trees constitute the first orchard in Kinderhook. Accordingly the trees in question are thought to be on their own roots and therein they differ from those of other less successful neighboring orchards.

To further substantiate the fact that these trees are on their own roots several stumps on interplanted "own-rooted" trees were cut through without finding any signs of graft or bud union such as can ordinarily be found with grafted or budded stock. Moreover Kieffer cions overgrow French stock, forming a conspicuous swelling. None of the own-rooted trees exhibited any such signs, the trunks and crown being smooth and symmetrical quite by contrast to the characteristic overgrowths to be seen on French-rooted trees nearby.

Additional evidence that the trees are on their own roots is given by an examination of suckers from the roots. French roots sucker freely and send up shoots with small, somewhat curled, oval leaves, readily distinguished from those of Kieffer. Kieffer roots, on the other hand, sucker little or none so that it is the exception to find an own-rooted Kieffer tree sending up suckers. This is true even when trees are cut down. Quite the opposite, it is an exception when a French-rooted tree does not sucker. In the orchard in question suckers were found with difficulty while neighboring orchards were suckering freely. In all cases the suckers from supposedly own-rooted trees were Kieffer and those from supposedly French stock were so determined.

The importance of the facts is demonstrated by the accompanying table, which gives the measurements of adjacent rows of own-rooted and French-rooted trees. The uniformity of the own-rooted trees is clearly shown, whereas the French-rooted trees lack uniformity and some have died. The difference between these two rows indicates the difference between Kieffer orchards in the Kinderhook section—the one vigorous, uniform, and profitable; the other lacking in vigor and uniformity and containing dead and unprofitable trees.

The answer is to be found partly in the better adaptation of the Oriental roots to light soils and droughty conditions, partly in the union of stock and cion, and partly in blight resistance. The first consideration explains itself. As for the second, Kieffer is the more vigorous growing stock of the two and in the northeastern States is generally considered to make a poor union with the common varieties of pears. This uncongeniality is probably a large factor. And finally Kieffer trees are more blight-resistant than those of the common pear. Suckering freely, the French roots are subject to the attacks of the blight organism (*Bacillus amylovorus*) which thus enters and may eventually result in the death of the tree.

Table I.—Trunk Diameters in Inches of Two Adjacent Rows of Kieffer Pear Trees—the One Own-rooted and the Other on French Roots

(Contrasting the uniform vigor of own-rooted trees with the variability and death of French-rooted.)

Tree No.	*Own Roots*	*French Roots*
1	9.2	5.2
2	9.1	6.5
3	8.6	5.6
4	8.2	6.1
5	7.8	5.5
6	7.5	6.3
7	9.3	Dead
8	8.7	6.1
9	9.0	3.2
10	8.8	6.0
11	7.1	4.7
12	9.2	5.4
13	8.1	6.7
14	7.7	6.0
15	8.1	5.3
16	8.9	7.1
17	9.1	Dead
18	8.8	Dead
19	8.8	5.1
20	8.5	6.6
21	7.4	4.7
22	8.8	6.7
23	8.2	7.1
24	8.5	6.3
25	8.5	6.9
26	9.7	Dead
27	9.3	6.5
28	9.9	8.3
29	7.6	2.9
30	9.4	7.2
31	9.7	7.1
32	9.6	Dead

HUMAN HYBRIDS IN VIRGINIA

A Review

A GROUP of three-race hybrids, compounded of Indian, white and negro blood, has been studied from the standpoint of sociology and eugenics.* A small Indian stock received a few early white crosses and several later accessions of low grade whites and negroes. This mixed community, living in a compact area in the foot-hills of the Blue Ridge mountains and socially isolated from its neighbors, now includes about 500 living members. Records were made of the descent and relationships of 658 individuals, going back through seven generations, for nearly 200 years. As thus presented, "The Win Tribe" evidently is expected to compete with the Jukes and the Kallikak families in sinister notoriety.

The motive for writing and reading such books is distinctly sanitary and clinical, like accounts of diseases and morbid growths. Detailed records must be made before the disorders can be understood, the causes determined, and the remedies devised. No general statement regarding such a group of people could convey an adequate impression of their subnormal state. How much of the degeneracy may be ascribed to hybridism, how much to adverse selection, and how much to unfavorable conditions, can only be determined as the facts are studied carefully. This branch of biology is still in a pioneer stage, with even the methods of study as yet only partially developed.

It is to be expected that degenerative effects of hybridizing will be found in the later generations of crosses between widely different human races as among hybrids of different species of plants and animals, that is, characters of remote ancestors are brought into expression, and characters that are definitely abnormal. Such facts forbid any confidence being placed in the idea that fusion or amalgamation is to be the final solution of the race problems, though the nature and extent of degeneration in different kinds of human hybrids have not been determined.

It may be that slight infusions of other blood can be added to a race without detriment, but this is a different question from forming generally mixed hybrid populations. Mixed people of ability and character are found, and families that show superiority in successive generations, but general results are not affected by exceptional cases. Whether the better families come from more recent or from more remote crosses is one of the questions to be considered in studies of race hybrids. No cases of special abilities are reported among the Wins, although a very wide range of physical differences is described. As an experiment in crossing, it may be reflected that the material was not the best of the component races, but this is not an objection to the practical value of the results, as such mixtures seldom are made with good material.

Aside from race questions, account should be taken of these mixed groups as an increasing element of the "rural residuals" who are to form the future peasantry of America "if nature takes her course." The decay of agriculture is inevitable if the inferior people are to remain in the country while the more capable families go to the city and are eliminated. In many parts of the United States the rural population already is much adulterated with defectives or deficients who produce children, but little else, and lack the initiative to move to the city. It is

*ESTABROOK, ARTHUR H., and IVAN E. MCDOUGLE. Mongrel Virginians—The Win Tribe. Published by The Williams & Wilkins Company, Baltimore, 1926.

self-evident that agriculture is backward in districts inhabited by people like the "Wins."

The nature of the material collected and the impressions gained by the investigators, are best shown by extracts. The general conclusion seems to be that the "racial integrity" law of Virginia is a step in the right direction for avoiding further race mixtures.

They are described variously as "low down" yellow negroes, as Indians, as "mixed." No one, however, speaks of them as white. The Wins themselves in general claim the Indian descent although most of them realize they are "mixed," preferring to speak of the "Indian" rather than of a possibility of a negro mixture in them. A few claim to be white. . . . . (p. 14).

Some are supposed to have only Indian and white blood.

Tht greater part, however, have a triple mixture; Indian, white and negro. Intellectually it is low grade but here and there are found family groups that stand out in the area; groups that maintain themselves with a very fair social response. In general the social reaction is very poor and the economic levels very low (p. 118).

The equivocal racial status is also indicated by a study of the marriage licenses.

. . . . There were seven matings where the parents gave no color in the license application and all kinds of "colors" are found in the children. Examining the records further we find that eleven persons were married twice. Five of these were married with the same "color" on the license at both registrations. Six, however, were married with a "color" different at the second from the first (p. 176).

Twenty-seven genealogical charts are given showing the supposed ancestry and relationships of the different branches of the "tribe," with running descriptions of individuals. Many pages are filled with this dismal and disgusting recital, but are not without points of interest from the standpoint of heredity, in addition to their documentary value, as racial and sociological data.

Hal had four sisters who will be taken up next. Two of these are unknown except by name. The others are Tabitha and Belinda. The former born 1809, is recalled as a little, brown skinned, almost full blooded negro who, it is related, lived to be almost one hundred years of age. Nothing is known of her life other than the fact that she had a daughter Lillie by a negro slave, this daughter born about 1825. It is said that this child belonged to the Taylor family as a slave. Saul Black, a white man, came to Ab County from Tidewater, Virginia, and settled on some land in the Win Country. He took Lillie: whether he bought Lillie as a slave is not known. He kept her on his rented place and had several children by her. She was very ignorant but evidently very industrious. She was very black and had kinky hair. As the children grew up, she treated the lighter ones of the family with greater respect than the dark ones and would not permit the latter to eat at the same table with the light ones. This greater consideration given to the lighter colored members of a family is often found among the Wins as noted elsewhere, but this was particularly true of Lillie. . . . (p. 119).

One member of the tribe may be said to have reached the stage of eugenic consciousness.

Felice had one illegitimate child by an unknown father. This boy, Daniel Johnson, born 1890, is part negro and recognizes that he has that blood in his veins and so will not marry out of that race; he feels that none of the Wins is good enough to marry, hence he has remained single (p. 117).

Consanguinous marriages are frequent in the Win tribe.

. . . . The social barrier erected in earlier times and still continued against the Wins by the whites and negroes of Ab County has been to a great extent the chief factor in forcing the Wins into matings with their own folks. This social barrier is not due to their own choosing as many of them consider it a desirable social asset to be married to a white person or one lighter than themselves. Hence matings on the part of the Wins into the white are much desired (p. 148-150).

. . . . Some few "stray" men have mated here and there. The James and the Nevins are low class white families. The Millers and Smiths came from a similar mixed area at Smithtown, about twenty miles away, also noted in this report. The Johnson family in earlier days was a low grade white family several of whose women mated into the group. Sam Long was a white boy brought up in a negro family and he married a Brown. Practically all of the out matings have been into poor stocks mentally. The consanguinous matings in the group are likewise of a poor stock into itself. The number of first cousin matings is comparatively small. A greater number is found in the second cousin column and an

almost equal number in the third column set. A survey of the chart shows no matings of either cousin or outbloods where there is apparently much difference in the offspring due to the consanguinity in one line and not in another. This is no doubt due to the fact that all the matings are from like poor stock (p. 150-1).

. . . . In some of the cousin matings, the children vary very much in ability, as in the children of Ulysses Jones and Helena Ross where several, Owen, "C," and "E," are much better in ability than the rest of their sibs. The Sandy Brown-Areta Brown cousin mating on the other hand has produced a set of children all of whom are very stupid mentally. Other examples of this may also be found (p. 151).

The Wins are very prolific, with an average production of 5 to 6 children per mother, and with only about 10 per cent of childless women, in comparison with 22 per cent among the Jukes. About 20 per cent of the births are reckoned as illegitimate.

. . . . In considering this difference of fecundity which seems significant, it may be of value to note that practically no syphilis is found among the Wins while it was comparatively prevalent among the Jukes. The social level of the Win area in Ab County, as to sexual morality, has been very low. This region is more compact in size than that of the Jukes and more opportunity for contact between the sexes may be possible, but it would not seem that this slight difference would influence the rate of reproduction in illicit matings to any great extent (p. 147-148).

. . . . The social consciousness of the Win region is so low that such illegitimacy, while a matter of common discussion is not looked down upon or frowned against in any way. The birth of an illegitimate child is taken as a matter of course and no social stigma placed upon the mother or on the putative father (p. 154).

. . . . Many factors have led to this. The home conditions of the people—many of them living in one room and few of them having more than two rooms in which to house a large family that may number ten or twelve—lead to a familiarity in sex matters. There has been no restraint on the part of the older ones and no response to the mores can take place by the children where the parents have no such respect (p. 156).

The mental attainments of the Wins, while showing much variation, have a remarkably low average.

The highest mental age secured by any child was 9.2 years by "B," then aged 11.5 years physically and in grade four, an Indian-negro mixture, more predominantly negro. At 12.5 age she is in grade five doing very fair work for the grade. . . . It is evident that only a small proportion of the children in the school group are even approximately a mental test age coincident with their physical age. Language difficulties did not interfere with the giving of the tests (p. 163).

The few examinations made and the general school results found, indicate that the Wins from an academic point of view are not very capable and much below the average for a like school of white children. The fact that no one has even been to high school is significant. This group is composed of intellects much below the average. Their schooling then should be practical and fitted for the lives they will live as tenant farmers and laborers for few of them have arisen from this level in which they are now and have been for many years (p. 168).

To what extent these slight attainments should be ascribed to adverse conditions for developing individual intelligence, is not considered. That the group traces back primarily to Indian women may help to explain a phenomenon that the authors would ascribe entirely to heredity.

. . . . The women have had little training in household matters—the result is poor living conditions. A few who have been trained in white homes when young keep better homes of their own later when married, depending to a great extent upon the husband being able to furnish one. The children as well as the adults are for the most part fed the year round on an infinite variety of combinations of corn and pork products. There are only two families which raise any garden truck and only three homes in the area keep chickens. Once in a while they do some trading at a country store but even then they cannot count money, making their purchases usually in terms of so many nickels. Very few could tell the value of either twenty-five or seventy-five cents (p. 200).

"The persistency of Indian traits among the Wins appears remarkable when the remoteness of pure Indian blood is taken into consideration. When one sees a group of men walking along the country road they will always be found parading in single file and for the most part noncommunicative. They are all very suspicious but this may be largely due to their geographical and their even greater psychological isolation throughout life. For the most part they are extremely diffident, reserved, timid, graceless, taciturn and very humble. There is practically no music among them and they have

no sense of rhythm even in the lighter mulatto mixtures. As is well known, the negro is "full" of music. Some of them have been given special training in music but no Win has ever shown any semblance of ability in this line. Not a single teacher or preacher has ever been produced by the group in its history and yet these characteristics are very typical in the negro. It would seem from these and many other observations that the negro temperamental characteristics are completely dominated by the Indian (p. 201).

Dominance of Indian characteristics hardly explains the musical deficiency. The Indian temperament is very different from the negro in the way of being more reserved and less talkative, but Indians often have a strong sense of rhythm, as well as a taste for poetry and eloquence. Perhaps the musical characteres of the two races are so different that neither kind of musical expression appears in the hybrids. The jazz movements and the Indian chants may inhibit each other and leave the hybrids dumb, as when blue pigeons are produced by crossing two white varieties.

A chapter on "Other Mixed Areas" enumerates and describes briefly several similar hybrid groups that are known to exist, in Virginia, Maryland, Delaware, North Carolina, South Carolina and Tennessee. Some districts have only a few hundred mixed people, others several thousands.

Unquestionably the people covered by this study represent an ever increasing social problem in the South. Social consciousness has only begun to be awakened. Amidst the furore of newspaper and pamphlet publicity on miscegenation which has appeared since the passage of the Virginia Racial Integrity Law of 1924 this study is presented not as theory or as representing a prejudiced point of view but as a careful summary of the facts in history (p. 202).

A copy of the racial integrity law is given as an appendix. The law provides a system of registration of the "racial composition" of each individual "who so desires," but "No marriage license shall be granted until the clerk or deputy clerk has reasonable assurance that the statements as to color of both man and woman are correct."

It shall be unlawful for any white person in this state to marry any save a white person, or a person with no other admixture of blood than white and American Indian. For the purpose of this act, the term "white person" shall apply only to the person who has no trace whatsoever of any blood other than Caucasian; but persons who have one-sixteenth or less of the blood of the American Indian and have no other non-caucasic blood shall be deemed to be white persons. All laws heretofore passed and now in effect regarding the inter-marriage of white and colored persons shall apply to marriages prohibited by this act (p. 204).

Another bill of the same character, to prevent further mongrelizing of the Indian and negro races in Virginia, came before the House of Delegates on February 13, 1928, but failed to pass by a vote of 13 to 26. According to newspaper reports, the bill defined as a negro "every person having any ascertainable degree of negro blood," and specified that "every person not a colored person, having one-fourth or more of Indian blood, shall be deemed an Indian."

Objection was taken to the bill on the ground of interfering more than necessary with the Indians "to make negroes of them." This was considered unjust and insulting to the Indian, instead of being appreciated as an effort to preserve the native race. The white race was held to be fully protected already under the existing law. "If an Indian has any drop of negro blood he can not marry into the white race." The new bill apparently is less stringent in accepting a person with one-eighth Indian blood as of the white race, while the existing law treats such persons as Indians. With the principle of race separation once adequately recognized, adjustments of the relations of particular groups might be considered with less prejudice. The first requirement is better knowledge of the biological consequences of racial crossing.

O. F. Cook.

GROWTH OF HORNS IN SHEEP

The Affect of Castration on the Development of Horns in Rambouillet Ram Lambs*

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IT has been known for some time that the interstitial cells of the testicles are the source of a hormone secretion which regulates the development of secondary sexual characters. It has also been observed that the removal of the testicles affects in a varying degree the secondary sexual characters, especially the horn development, in horned breeds of sheep and cattle.

Davenport[1] points out that castration lessens the growth of horns in sheep whereas in cattle it makes them slightly longer and a little more slender. Marshall[2] in working with the Herdwick breed of sheep (males only are horned) found that castration at varying ages invariably caused a cessation in the growth of the horns of males. Mumford[3] has found that if the male in the Merino breed (Males only are horned but females may have scurs) is castrated before the horns begin to develop, the horns fail to grow and the wether remains hornless, and that if the males are castrated after the horns have started to develop, the horns cease to grow. Smith[4] and Winters[5] also conclude that incomplete development of the horns accompanies castration of a horned ram lamb.

Specific information bearing upon the introductory remarks has been secured from work on Rambouillet ram lambs (males have horns and ewes may have scurs). Four ram lambs each six months of age and comparable in size and sexual development were used in securing the data. Two of these were left entire throughout the period and will be known as Group I. The other two were left entire for three months and then castrated. They will be known as Group II. The castration was performed just as soon as the measurements had been made at the end of the third month. Measurements were made every thirty days with two standard vernier callipers and a steel tape. The length was taken along the outside or longest curve of the horn. The diameter reading was the largest obtainable at the point indicated. The total spread between points or exterior horn ends was taken with a large calliper.

When the first measurements were made Group I had an average horn length of 24.83 cm. and Group II 23.80 cm. while the largest diameter readings at the base of the horns were respectively 5.94 cm. and 5.64 cm. When comparing the total growth during this six months period with the growth made during six subsequent months it will be noted that the rate of growth is more rapid during the earlier period.

It would seem from the data presented in the accompanying table that the affect of castration is not only quite immediate, but also rather complete, very little growth in length or diameter being indicated during the last period. The total length growth in Group I for the first three periods was 8.09 cm. and for Group II 8.00 cm. while for the last three periods the horns in Group I grew 6.65 cm. as compared with 1.68 cm. in Group II, only 11.9 per cent of which occurred

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GROWTH OF HORNS IN RAMBUILLET RAMS

Figure 5

Contrasting horn development in two rams twelve months of age. The upper head shows normal growth. The lower shows the characteristic changes produced by castration at the age of three months, the horns smaller and less curved.

in the last period, indicating a significantly diminishing rate of growth.

Observation and measurements were made on the space between the horns at the poll. Breeders watch rather carefully to get Rambouillet rams not "too tight" in the horn. On some rams the horns at this point grow so closely that they crowd, a feature objected to quite severely. In Group I this space at the beginning of the test was 3.32 cm. and at the close 1.80 cm. In Group II the space changed from 2.50 cm. to 1.32 cm. This tendency for the horns, in their development at the base, to grow together is rather apparent and would indicate the advisability of exercising precaution in selecting Rambouillet rams not "too tight" in the horn in the early stage of growth.

At the beginning of the test two notches were made on the top side of each horn ten and twelve centimeters respectively from the base, and measurements were made from the base of the horn to these notches as well as to the tip of the horn at the end of each period with the result that the growth from the notches to the tip during the entire time was negligible and that the growth was exclusively indicated in the section between the base and the notches. Horns in Rambouillet rams grow from the base only, there being no growth evident in horn tissue beyond this point. Calliper readings were also made each time of the largest and smallest diameters of the horn at the notches which also indicated that there was no growth in the diameter of the horn at these points.

In conclusion it may be said that the castration of Rambouillet ram lambs reduces the growth of horns to about one-third in a period of four weeks and to about one-tenth in twelve weeks. Increase in diameter and length occurs entirely at the base of the horn, and growth in the two directions is affected similarly by castration. While the spread between the horn points is not so significant because of the varying tendency to spiral, the data is given in the table as it suggests the trend indicated in the other measurements.

TABLE I.—Growth of Horns on Rambouillet Ram Lambs by Thirty-day Periods in Centimeters

Group	*Length*					
1	2.48	2.77	2.84	2.54	2.01	2.10
2	2.47	2.80	2.73	.89*	.59	.20

GROWTH CUURVES OF HORNS

Figure 6

Showing very marked change in growth rate produced by castration.

	Diameter at Base							*Spread between horn points*					
1	.15	.22	.28	.26	.24	.17	1	.98	.85	.75	.70	.70	.80
2	.24	.30	.35	.09*	.04	.01	2	1.15	.98	.90	.43*	.24	.13

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Human Genetics

E. Baur, E. Fischer und F. Lenz, Menschliche Erblichkeitslehre und Rassenhygiene, Band I, Menschliche Erblichkeitslehre. 3. Auflage. Pp. 201. Price 18 marks. München, 1927.

Since this book, probably not only in Germany, is accepted as the standard textbook of human genetics, its new edition scarcely needs to be recommended. Little had to be changed in the first part of the book which gives E. Baur's outlines of general genetics. This chapter is a veritable model of clarity and conciseness. In the second part E. Fischer discusses the racial characteristics of man. It includes a critical review of the different constitutional types and their value for anthropological classification. The foreword also announces a new chapter dealing with the blood groups and their racial significance; unfortunately, this discussion seems to have been omitted in the text. The three concluding parts of the book (all by F. Lenz) concern the inherited pathological characters, the methods of research of human genetics, and the inheritance of mental traits. These chapters have undergone considerable change and increase. Many new family trees and much of the more recent literature have been included. The part dealing with the inheritance of pathological traits undoubtedly is the most complete source of up-to-date information of its kind. Geneticists interested in human inheritance will be particularly grateful for the author's clear and detailed accounts of the medical and pathological side of the problems; this, especially since it is of the greatest importance that students in this field familiarize themselves with all the features of a given trait in order to avoid the summarizing of incongruent cases which in the past undoubtedly has obscured the mode of inheritance of many human traits. Since many investigators will refer to his first volume only, it is to be welcomed that a separate index was added.

Walter Landauer.

THE EFFECTS OF A LETHAL ON THE HETEROZYGOTE IN MAIZE

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WHENEVER a variety of maize is self-pollinated, a miscellaneous assortment of recessive characters, previously covered up by the remarkable heterozygosity which prevails in most varieties of corn, is brought to light. Most of these recessives have a decidedly deleterious influence in the homozygous condition and a large majority of them, particularly white seedlings and defective seeds, are completely lethal in their effect.

It has been generally assumed that these recessive variations, which have a definite depressing influence in the homozygous condition must also have some degree of expression, however slight, in the heterozygote. This would appear to be a reasonable assumption, since complete dominance has proven to be the exception rather than the rule.

On the assumption that these recessive factors do have an effect when in a heterozygous condition, and because they detract from uniformity, it is a common practice in corn improvement work, to remove them permanently from the germplasm by inbreeding. This has brought up the question of the effect of removing the recessives on other genetic factors in the germplasm. Lindstrom[3] suggests that these factors may be linked with other factors that are especially favorable for growth and development, and that the removal of the recessives may result in the permanent loss of closely linked groups of superior genetic factors. Mangelsdorf[4] has pointed out, however, that these lethal and semi-lethal factors may persist through linkage with other deleterious factors thus tending to keep short sections of the chromosomes which bear them in an enforced state of heterozygosity. Such a condition would permit the accumulation of inferior factors rather than superior ones.

The possibility of this situation has already been demonstrated in other organisms. Muller[5] calls attention to the protection which balanced lethal factors afford to other mutative changes during evolution and regards the process as a form of "chromosome degeneration." Shull[6] states that non-lethal forms of Oenothera are usually inferior in vegetative vigor, rapidity of development, or degree of fecundity to the lethal bearing types.

Before proceeding further with these theoretical considerations, important though they be, it would seem advisable to determine definitely whether or not recessive variations in maize do have an effect in the heterozygote, and how great this effect it.

Previous Studies

Lindstrom,[2] in recording the inheritance of white seedlings in maize, states that: "it has been observed that plants heterozygous for the *W* factor are slightly less vigorous than normal green plants—the plants show a tendency toward producing only a single stalk which finds great difficulty in standing up in a strong wind. It is only rarely that a sucker is produced."

Mangelsdorf[4] measured 1047 F_1 plants of which part were heterozygous for

*A word of appreciation is due the Connecticut Agricultural Experiment Station for permission to publish these data which were obtained by the writer while a member of its staff

one defective seed factor, part heterozygous for two defective factors and the remainder homozygous for the normal allelomorphs. The heights of these three classes were 73.85, 73.30, and 74.90 inches, respectively. Although the plants lacking the lethal factor proved to be the tallest, the plants heterozygous for one factor ranked next in stature, and the plants heterozygous for two factors were the shortest, and though the rank of these three classes with respect to stature was the same in two consecutive seasons, the difference between their means was small in relation to the probable error and did not appear to be statistically significant. If, however, the order in which these three classes ranked was due entirely to chance we should expect this particular ranking to occur only once in six trials, and to occur in two consecutive years, only once in 36 trials. In all probability, therefore, the slight differences in height in these three classes were more than mere chance fluctuations.

In both of these cases it is impossible to say whether the slight differences between *Ww* and *WW* or between *Dede* and *DeDe* genotypes were due to the action of the recessive factors *per se* or to other factors with which they were closely linked. It is evident that the true effects of the recessive factors cannot be definitely determined unless all other genetic factors, at least all those in the same linkage group, are held constant.

A Recessive Mutation In A Homozygous Stock

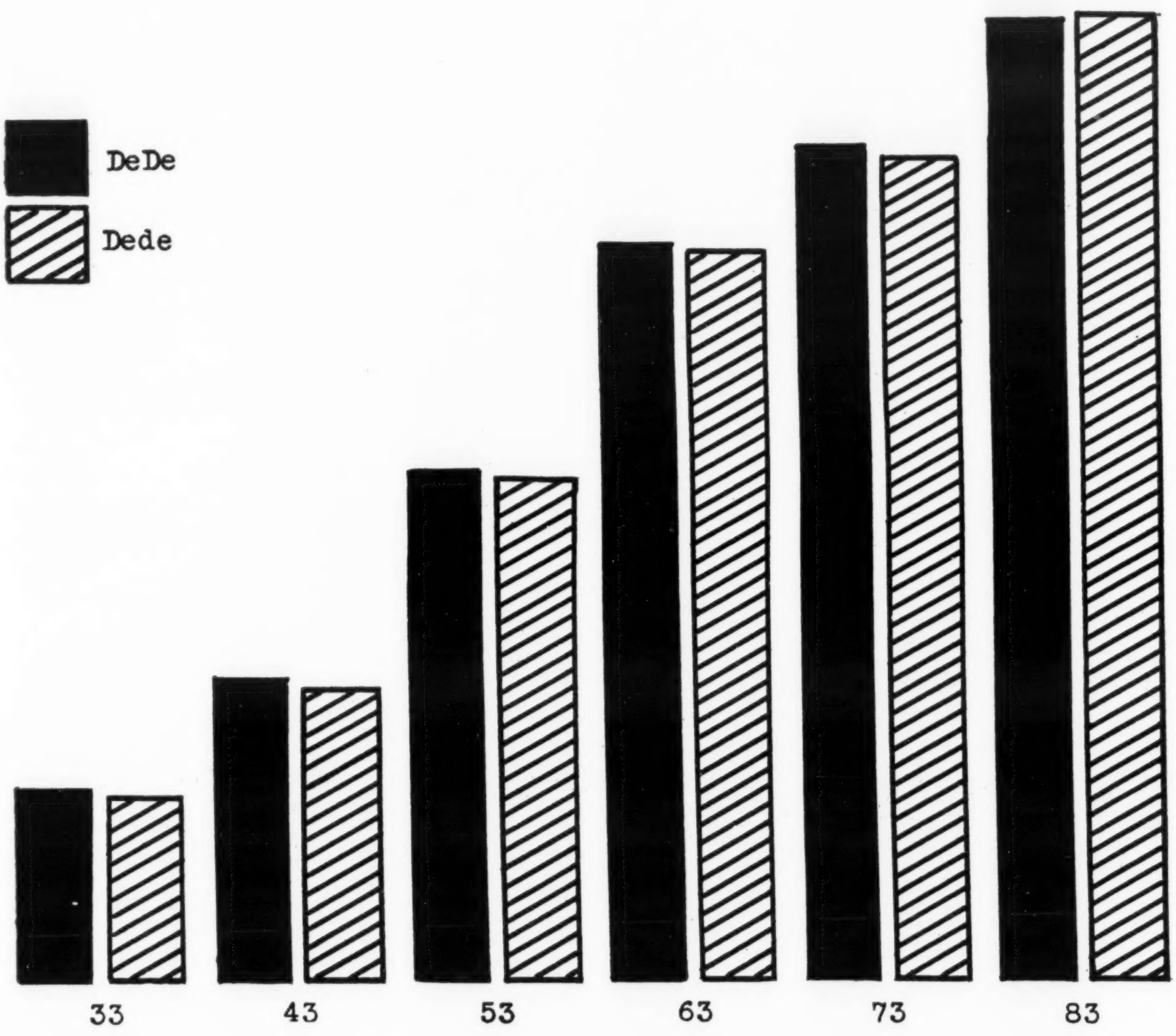
The opportunity to test the effects of a recessive lethal in maize, with all other genetic factors remaining constant, was presented when an inbred strain of Chester's Leaming, which had been continuously self-fertilized for thirteen generations, mutated to a defective seed type. This mutation, which is briefly described in a previous paper as de_7, proved to be inherited as a simple Mendelian recessive. A count of the seeds on nine segregating ears showed a ratio of 706 normal seeds: 254 defectives. The deviation from a theoretical monohybrid ration is 14 ± 9.0

The recessive seeds are characterized by smaller size, shrunken and shrivelled condition and the absence of endosperm color. Both embryo and endosperm are present though both are reduced in development. The embryo is severely aborted while the endosperm is soft and chalky in texture and very rarely contains any corneous starch or exhibits any endosperm color. Of the thirteen genetically distinct defective seed types which the writer has studied in some detail, this one is the easiest to identify. It is completely lethal in its effect, usually showing no germination whatever in the original stock, even under optimum conditions. When defective seeds are borne on vigorous F_1 plants, however, their development is usually greater and occasionally a defective seed of this type, capable of germination, is encountered. These, however, produce weak, abnormal, seedlings which soon die. Though thousands of seeds of this defective have been planted, a plant homozygous for this character has never been obtained.

The genetic change which occurred in this old inbred strain to produce the characters described above, was apparently confined to a single factor locus. Segregating ears and plants of this strain were not different in noticeable morphological characteristics from non-segregating individuals and it is probably safe to assume that the genetic constitution of this stock, with respect to all other genetic factors, remained the same. On this assumption the constitution of plants heterozygous for the recessive factor or homozygous for its dominant allelomorph is as follows:

Homozygous—*DeDeAABBCC—XX*
Heterozygous—*DedeAABBCC—XX*

In this factorial representation *de* indicates the gene for defective seeds, *De* its normal allelomorph, while the



GROWTH OF TWO CLASSES OF PLANTS

Figure 7

In every measurement except the final one, the plants lacking the lethal factor were slightly superior to those which carried it.

factors *ABC—X* represent all other genetic factors involved.

Measuring the Effects of A Single Gene

Instead of measuring the effects of this gene on plants of an inbred strain which are considerably below normal in vigor and productiveness, it was considered more advisable to test its action in normal, vigorous F_1 plants. For this reason the inbred strain carrying the lethal factor was crossed with another inbred strain, which for all practical purposes was also homozygous in all its factors.

The F_1 plants from such a combination are expected to be heterozygous for a large number of their genetic factors. They are, however, uniform in constitution with the exception that half of them are heterozygous for the lethal factor and half are homozygous for its dominant allelomorph. The genetic constitution fo these two classes of F_1 hybrids may be represented as follows:

Homozygous—*DeDeAA'BB'CC'—XX'*
Heterozygous—*DedeAA'BB'CC'—XX'*

In all of their genetic factors except the *Dede* pair these two classes are identical. Any differences between them

may, therefore, be assumed to be the result of the differential effects of the *DcDc* and *Dcdc* factor combinations.

A population of F_1 plants comprising the two classes represented above was obtained by crossing an inbred strain of Beardsley's Leaming with pollen from a segregating progeny of the inbred strain of Chester's Leaming. Pollen was taken from numbered plants which were also self-fertilized at the same time to determine their composition with respect to the *Dcdc* factor pair. Three ears, which had been pollinated by plants of the composition *Dcdc* were obtained.

The seeds from these crossed ears were planted in 1925 in short rows on as uniform a piece of land as was available and were spaced as accurately as possible. Three seeds were planted in each hill and later the seedlings were thinned to one per hill, the extra plants being removed at random, without regard to vigor, appearance, or other characteristics.

The population, then, consisted of F_1 plants, fully as vigorous as ordinary open-pollinated maize, and all identical in genetic constitution except that half of them, theoretically, were *DcDc* and the remainder *Dcdc* in composition. Since these two genotypes were distributed throughout the field entirely at random, there was little opportunity for soil variability, or other environmental variations to affect the results.

Experimental conditions in this test were almost ideal. The season was excellent and the plants developed normally, every plant in the field reaching maturity. No insect damage occurred and only one plant was injured by smut. Grain production was confined to a single, well developed ear on each stalk. No second ears were produced except on one plant.

The plants were first measured at 33 days after planting and at regular ten-day intervals thereafter until maturity. Time of anthesis was recorded by dating and tagging, every 24 hours during the blooming season, all plants which had begun to shed pollen. All these data were taken before the *DcDc* and *Dcdc* plants could be distinguished and there was no opportunity for a personal factor to affect the results.

When mature, the ears were harvested, measured and weighed. After all data had been recorded the plants were classified into homozygous and heterozygous on the basis of their segregation for defective seeds. The ears had not been self-pollinated but since the pollen mixture in this field comprised, theoretically, three-fourths of the pollen carrying the *Dc* factor and one-fourth the *dc* factor, it was to be expected that half of the ears would have approximately one-eighth of their seeds defective, and that the remaining ears would exhibit only normal seeds. All ears which showed any defective seeds were classified as *Dcdc;* ears which bore only normal seeds were called *DcDc*. There is of course, the possibility that a plant of the composition of *Dcdc*, because of its chance position among a group of *DcDc* plants, would receive a preponderance of *Dc* pollen grains and would show no defective seeds. The distribution of a sample of 50 segregating ears with respect to the number of defective seeds per ear, indicates that this possibility is remote. Only two ears in 50 had less than fifteen and only one additional ear had less than 20 defective seeds, as shown in Table I.

A total population of 202 plants of this cross was grown to maturity. Two of these were discarded in analizing the data; one because it had smut and bore no ear, the other because it produced two small ears and was not directly comparable in length and weight of ear with the remaining plants, all of which were free from smut and bore a single, well-filled ear.

Of the remaining 200 plants, 96 were segregating and 104 were not. The deviation of this ratio from the theoretical 1:1 ratio is well within

EMBRYO DEVELOPMENT RETARDED BY LETHAL FACTOR

Figure 8

A normal seed and two stages of development of the defective seeds produced by the action of a lethal factor. In the homozygous condition the lethal factor arrests development at an early stage. In the heterozygote its effect on rate of development, earliness of blooming and yield, is very slight.

the limits of random sampling, being less than the probable error.

Differences Between Homozygous and Heterozygous Plants

The height of the homozygous and heterozygous plants at successive stages of development is shown in Table II. The first four measurements were made to the tip of the longest leaf on each plant; the two last measurements to the base of the tassel. This abrupt, though necessary change in the basis of measurement probably accounts for the slight change in the direction taken by a growth curve plotted from the measurements in Table II and illustrated in Figure 7.

It is evident that the *DcDc* plants were slightly taller than *Dcdc* plants at every period when measurements were made, except the final one. In only one case, however, the height at 33 days, is the difference between the two classes more than three times the error. It would appear that there was a real difference between the *DcDc* and *Dcdc* plants in the earlier stages of development and that this difference was gradually overcome later, the successive differences between the two classes being 1.01, .98, .64, and .57 inches or 4.6, 2.9, 1.1, and .7 per cent, during the period that measurements were taken to the tip of the longest leaf. When the plants reached their maximum stature *Dcdc* plants were actually slightly taller than *DcDc* plants, though the difference between the two classes, .94±.467 inches, is not significant.

The frequency distribution for number of days to anthesis is shown in Table III. The *DcDc* plants came into bloom slightly earlier than did *Dcdc* individuals but here, again, the difference, .53±.255 days, is not significant.

Nor is there a significant difference between the two classes in length and weight of ears, although the *DcDc* plants are, in both cases, slightly superior to those of the *Dcdc* class, as set forth in Tables IV and V.

The data on weight of ears may be open to objection because the segregating ears all bear some defective seeds. Since the weight of defective seeds is only a fraction of that of normal seeds, it might be supposed that the presence of 36.6 aborted seeds, the average number per ear, would cause a significant reduction in the total weight of the ear.

To arrive at some estimate of the extent of this reduction, two groups of ten kernels each were removed from 50 of the segregating ears. One of these groups included a defective seed with nine normal kernels surrounding it. The other group consisted of ten normal kernels, unaffected by the presence of defective seeds.

The total weight of the 50 groups of ten normal seeds each was 168.0 grams or an average weight per seed of 336 mg. The total weight of the 50 groups each containing nine normal and one defective seed was 162.3 grams with an average weight of 340 mg. for the normal seeds and 190 mg. for the defectives. Apparently the presence of a defective seed permits the normal seeds immediately surrounding it to attain a greater development. In any case the presence of 50 defective seeds in the second group caused a total reduction of only 5.7 grams or a reduction of 114 mg. for each defective seed present. The average number of defective seeds on these 50 ears was 36.6 so that the total reduction in weight, due to their presence was approximately 4.17 grams or .15 ounces per ear. This is probably the maximum reduction. It is possible that the loss in weight due to the defectives is completely compensated by the increased development of other kernels on the same ears, and not included in the measured groups.

In earliness of blooming, length and weight of ears, height of plant in the first five periods of measurement, all characters by which vigor in maize may be measured, the *DcDc* plants proved to be slightly superior to *Dcdc*

individuals. Although the difference between the genotypes is statistically significant in only one case, height of plants at 33 days, it seems fairly certain that the other differences are not merely the result of chance fluctuations. If only chance fluctuations in measurement were involved it would be expected that the mean of the *Dedc* class would be below that of the *DcDc* genotype as frequently as it is above. This is not the case. In eight of the nine measurements the homozygous class proved to be superior to the heterozygous one. Such a distribution is expected by chance alone only once in approximately 57 trials. Since odds of 22 to 1 are generally regarded as indicating significance in biological experiments under controlled conditions, it would seem safe to conclude that the differences between the *DcDc* and *Dedc* plants, extremely small though they may be, are inherent and not merely due to chance errors in measurement.

Further evidence for this conclusion is found in the fact that the difference in height between these two classes is gradually reduced and the reduction appears to follow a fairly definite trend. The possibility that the values have assumed this definite arrangement by chance alone, is remote indeed.

Improvement Through Elimination of Recessives

In previous observations on the effects of lethal factors of maize in the heterozygous condition, the situation has been complicated by the possible occurrence of other factor differences in the same chromosome pair bearing the recessive gene and its normal allelomorph. Under such conditions the observed differences between homozygous and heterozygous plants cannot be definitely attributed to the effects of the recessive factors in question.

In the experiment recorded here, all genetic factors with the exception of the *Dedc* pair were constant. The two genotypes comprising the population were distributed at random throughout the field and all of the data were recorded before the two types had been identified. Any observed differences between the two classes of F_1 plants can, with a reasonable degree of confidence, be attributed to the action of the *dc* gene in a heterozygous condition.

It has been shown that the *DcDc* plants were slightly superior to those of *Dedc* composition in height of plant at five different periods of development, in earliness of blooming, and in length and weight of ears. The significance of these small differences has been fairly well established. It would appear safe to conclude from these facts that this recessive lethal factor does have an effect in the heterozyous condition and that this effect is extremely slight.

Since the reduction in vigor and productiveness resulting from the presence of the lethal factor is so slight in heterozygous plants, it becomes almost negligible when applied to an entire crop. Hutchison[1] and Mangelsdorf,[4] have found that in ordinary open-pollinated varieties of maize, one plant in thirty, on the average, is heterozygous for a defective seed factor. The defective seed, studied here, caused a reduction of 4.2 per cent in the yield of heterozygous plants. If under natural conditions it occurred in only one plant in thirty, it would reduce the yield of the entire population only 14/100 of one per cent.

To account for an increased yield of 20 per cent over the original variety when two inbred strains from that variety are re-combined, approximately 120 recessive factors with an effect equal to that shown by this defective seed factor would have to be eliminated from the germplasm, if the increased yield has been entirely due to the removal of deleterious recessives.

It is possible, of course, that other recessive factors have a greater effect

Table I. Number of defective seeds on open-pollinated Dede plants.

Mid-class values	13	18	23	28	33	38	43	48	53	58	63	68	Mean
No. of plants	2	1	6	9	7	8	4	5	3	1	3	1	36.6

Table II. Stature of DeDe and Dede Plants at successive stages of development

Genotype	Height in inches at 33 days: 12	15	18	21	24	27	30	N	Mean	Relative
DeDe	2	4	15	34	38	10	1	104	21.92 ± .219	100.0
Dede	1	6	32	23	24	10		96	20.91 ± .239	95.4
							Difference		1.01 ± .323	4.6
	Height in inches at 43 days: 21	24	27	30	33	36	39	42			
DeDe	2	2	3	17	25	41	13	1	104	33.95 ± .255	100.0
Dede	1		13	21	25	23	12	1	96	32.97 ± .274	97.1
							Difference			.98 ± .473	2.9
	Height in inches at 53 days: 43	46	49	52	55	58	61	64	67			
DeDe	1	5	6	11	19	19	26	12	5	104	57.45 ± .358	100.0
Dede	1	2	7	16	21	15	22	9	3	96	56.81 ± .350	98.9
							Difference				.64 ± .501	1.1
	Height in inches at 63 days: 66	69	72	75	78	81	84	87	90	93			
DeDe	1	4	5	7	6	20	21	24	12	4	104	82.88 ± .396	100.0
Dede	1	1	2	10	18	15	17	20	10	2	96	82.31 ± .376	99.3
									Difference			.57 ± .547	.7
	Height in inches at 73 days: 63	66	69	72	75	78	81	84	87	90	93	96	99	102	105	108			
DeDe	2	1	1	1	2	4	4	4	9	5	13	14	12	17	12	3	104	93.72 ± .669	100.0
Dede		1		1	2	3	6	9	13	8	12	6	9	18	6	2	96	92.50 ± .619	98.7
														Difference				1.22 ± .913	1.3
	Height in inches at 83 days: 95	98	101	104	107	110	113	116	119										
DeDe	3	2	7	16	23	21	20	10	2								104	108.47 ± .342	100.0
Dede		1	4	14	26	20	15	12	4								96	109.41 ± .318	101.0
									Difference									.94 ± .467	1.0

Table III. Number of days to anthesis in DeDe and Dede plants.

Genotype	Mid-class values in days: 66.5	68.5	70.5	72.5	74.5	76.5	78.5	80.5	N	Mean	Relative
DeDe	2	13	21	41	15	8	2	2	104	72.35 ± .177	100.0
Dede		11	18	32	17	15	1	2	96	72.88 ± .186	100.7
								Difference		.53 ± .255	.7

IV. Length of ears from DeDe and Dede plants

Genotype	Mid-class values in Cm.: 17	18	19	20	21	22	23	24	25	26	N	Mean	Relative
DeDe	2	2	2	6	5	17	28	21	16	5	104	22.93 ± .126	100.0
Dede	1	1	4	6	8	18	27	15	13	3	96	22.70 ± .124	99.0
										Difference		.23 ± .177	1.0

V. Weight of ears from DeDe and Dede plants

Genotype	Mid-class values in ounces: 4	5½	7	8½	10	11.5	13	N	Mean	Relative
DeDe	1	8	7	27	34	17	10	104	9.52 ± .134	100.0
Dede	1	4	14	28	34	14	1	96	9.12 ± .116	95.8
							Difference		.40 ± .177	4.2

in the heterozygote than does this particular defective seed factor. It is equally probable that a majority of them have even a slighter effect. The writer[4] has pointed out that factors for defective seeds, do not affect specifically the endosperm or embryo but that those which are viable in a homozygous condition have a depressing effect on all stages of sporophyte development. These factors which have a general deleterious influence at all stages of development might reasonably be expected to exhibit a greater effect in the heterozygous condition than would, for example, the many factors for white seedlings which affect specifically a certain process, the development of chlorophyll.

The problem, however, calls for additional study and it is suggested that other investigators take advantage of new characters which occasionally arise by mutation in homozygous inbred strains of maize, to study the effects of recessive factors in a heterozygous condition with all other genetic factors held constant. By utilizing these recessives before other factor differences have occurred in the same chromosome pair and by comparing their effects under conditions of genetic constancy with the effects of a similar group of recessives already present in a variety, it may be possible to determine whether these recessives tend to become linked with superior factors for growth and development or with inferior ones.

Even though they do tend to become linked with superior factors there is probably nothing lost in removing them from the germplasm. These factors in order to survive would need to accumulate only enough superior factors to compensate for the slight depressing effect which they themselves may exhibit, so that in removing them nothing is lost nor gained. If, however, they survive by keeping short sections of the linkage group in a state of enforced heterozygosity and in so doing, permit the accumulation of inferior factors in this heterozygous region, then their elimination from the germplasm becomes doubly important. Disregarding, however, the slight change in either direction which their elimination may have upon productivity, the effect of their presence on the uniformity of the stock, is still sufficient justification, from the standpoint of the practical breeder, for their removal.

Author's Note: Since this paper was submitted to the Journal of Heredity, two papers on the effects of recessive factors in the heterozygous condition have appeared, one dealing with a defective factor in maize[7]; the other with the "glabrous" character in soybeans.[8] Both papers report reduced productiveness in the heterozygous plants, though in the case of soybeans, the difference is not statistically significant. In both cases, as well as in the two cited above, the authors measured, not the effects of the recessive genes *alone*, but the effects of the recessive genes *plus* any associated factors with which they might have been closely linked.

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DO POTATO VARIETIES DEGENERATE IN WARM CLIMATES?

Examples of Vigorous Potato Clones in Ohio

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THE OLD AND THE NEW IN POTATO VARIETIES

Figure 9

The Long John (above) compared with the modern Russet Rural. The Long John has retained its vigor for 90 years in Ohio.

DEGENERACY, or "running-out," of potato varieties is prevalent throughout the United States, but is particularly serious in the southern and central regions. Most investigators today attribute the loss of vigor wholly to virus diseases. But in spite of the recognized importance of these so-called degeneration diseases, the view persists that unfavorably high summer temperatures, entirely aside from infectious

diseases are, in some degree, responsible for the degeneration.

In Ohio and some other central states which are now certifying seed potatoes, the question is of particular interest. Certification officials proceed on the assumption that unfavorable weather conditions are not injurious to the reproductive value of the tubers.

At first this assumption was based upon the genetic theory of the constancy of the hereditary complex in vegetative reproduction, rather than upon specific studies with the potato. As the work in Ohio has proceeded, however, the position appears to have been justified by comparative tests of local seed potatoes with certified seed from northern Michigan. During four years that such tests have been conducted, the disease-free Ohio seed has yielded as well as northern seed.* Due to the the difficulty of controlling virus diseases, the production of certified seed in Ohio is still very limited; but, aside from disease, there is no indication in comparative tests of any degeneration directly due to high summer temperature.

A Ninety-Year-Old Variety

Four years, however, is an inadequate period upon which to base a conclusion that slow degeneration is not occurring. Consequently, a search was instigated to discover potatoes that had been grown for long periods in Ohio. The most interesting instance that has come to the writer's attention is an old variety, called the Long John, which is being grown by W. A. Lewis on his farm, ten miles west of Wooster. According to Mr. Lewis, the variety was brought to this vicinity from Pennsylvania by his grandfather, in 1836, and has been grown by the family for table potatoes ever since.

A sample of the Long John was grown at the Experiment Station in 1926 in comparison with the modern Russet Rural, the leading variety of northern Ohio. The Long John showed no symptom of any virus disease. The tops of the old and new varieties were very similar. The tubers of the old variety, however, were irregular and unattractive when judged by modern standards. Unfortunately, as the autumn was very wet and some tubers rotted in the ground in both varieties, no accurate comparisons of yield were possible, although there were indications that the old variety yielded slightly less than the new. This may be taken as evidence of degeneration; but in view of the fact that in the historical succession of varieties, new varieties supplant the old, both because of superior yields as well as of superior quality, slightly lower yield in an old variety is certainly not conclusive evidence of degeneration. The variety then stands as an example of a high degree of vigor after 90 years of adverse summer temperatures in Ohio.

Two lesser instances may be mentioned. A prominent grower of south-central Ohio has maintained one of the Rural varieties (Carman No. 3) in a high degree of vigor for 15 years. In recent seasons his yields have been more than 200 bushels per acre above the state average. His high yields are in part due to his practice of applying a straw mulch. In view of Emerson's success with mulch in Nebraska,† it is possible that the straw mulch may be partly responsible for the maintenance of vigor in this Ohio strain.

The other instance is that of a seed potato specialist in northern Ohio, who, since 1906, has produced excellent seed stock on a commercial scale. As a means of reducing the spread of virus diseases he has adopted the policy of delaying planting until late June, a practice which places tuber development during the cooler weather of late summer and fall. However, in some seasons hot weather prevails during late August and early September, and as yet his stock shows

no sign of degeneration. At present his seed potatoes are widely sought in northern Ohio, and yield as well as certified seed from farther north.

These three instances, together with the recent success in certifying seed potatoes in Ohio, are in accord with the view that degeneration of potatoes is entirely due to diseases rather than to any direct effect of high temperature, itself, upon the hereditary complex. From a genetic viewpoint there is no reason why further efforts should not be put forth to produce and maintain seed potatoes in this climate.

*Bushnell, John, and P. E. Tilford. Suggestions on the method of producing seed potatoes. *Ohio Agr. Exp. Sta. Bimon. Bul.* 12:41-44. 1927.

†Emerson, R. A. Home mulched vs. northern seed potatoes for eastern Nebraska. *Neb. Agr. Exp. Sta. Bul.* 146. 1914.

Rubber Reported in the Panachee Fig

A description and several illustrations of the Panachee fig appeared in The Journal of Heredity for February, 1928. A tree of this variety in California was reported in the newspapers a few months ago as containing rubber "in commercial quantities," and several rubber journals copied the announcement, as in the following statement from *The Rubber Age* for October 10, 1927.

Initial experiments recently carried out by Dr. Frederick Osius, in the extraction of rubber from fig trees, have proved successful, according to an Associated Press dispatch from Pasadena, California. Dr. Osius, in making his announcement, said that rubber in commercial quantities may be obtained from the panachee, or French Fig, and that the common California varieties, the Kadota and the Adriatic, are being subjected to research processes now. He said he had produced a fine piece of rubber from panachee milk.

Since rubber is obtained from *Ficus elastica* and many other species of Ficus and related genera, its occurrence in some of the cultivated varieties of *Ficus carica* is not improbable. In most cases only very small quantities of rubber are likely to be found, but some of the varieties may have richer latex, or special conditions may lead to the formation of usable rubber. Most of the figs contain weak sticky gums which may coagulate and show an appreciable elasticity for a short time, but soon lose their structure and become very brittle when dry.

THE ORIGIN OF CERTAIN THORNLESS BLACKBERRIES AND DEWBERRIES

H. M. Butterfield
University of California

FUTURE plant breeders may benefit by having a record of the origin of the most popular varieties of thornless blackberries and dewberries. The three varieties which have been receiving the greatest publicity include the Cory Thornless blackberry (Thornless Mammoth), the Thornless Austin dewberry, and a group of thornless blackberry seedlings ordinarily classed as the Burbank Thornless. A brief history of these varieties follows.

Cory Thornless Blackberry

Charles Beede, who was working for Martin Muehli in 1908 near Chinese Camp, California, noticed a thornless cane on a Mammoth blackberry plant which stood at the end of a berry row and upon investigation he found that only one of six canes was thornless. Mr. Beede became interested and cut off all the thorny canes. He then rooted the tip of the thornless cane and propagated a few thornless plants. Later, in an attempt to secure plants from the roots Beede made cuttings of the whole root but all plants grown from root cuttings of this variety were thorny.

About 1911 Beede went to work for Walter C. Cory, a neighbor, who became very much interested in the possibilities of the variety and shared the interest of young Beede. Cory finally secured control of the variety and soon he had the name "Cory Thornless Blackberry" copyrighted. He propagated the variety and had about 1¾ acres of it when the Extine Nursery of Modesto contracted for all of the plants for a period of two years and, through them, he handled between 50,000 and 60,000 rooted tips.

Cory continued to grow and sell the Cory Thornless until about 1918 when he disposed of his rights in the berry variety. His father, J. D. Cory, took over its distribution and has continued to sell plants up to the present time.

The Cory was first exhibited at the International Exposition at San Francisco in 1915. In 1917 it was exhibited at the California State Fair at Sacramento.

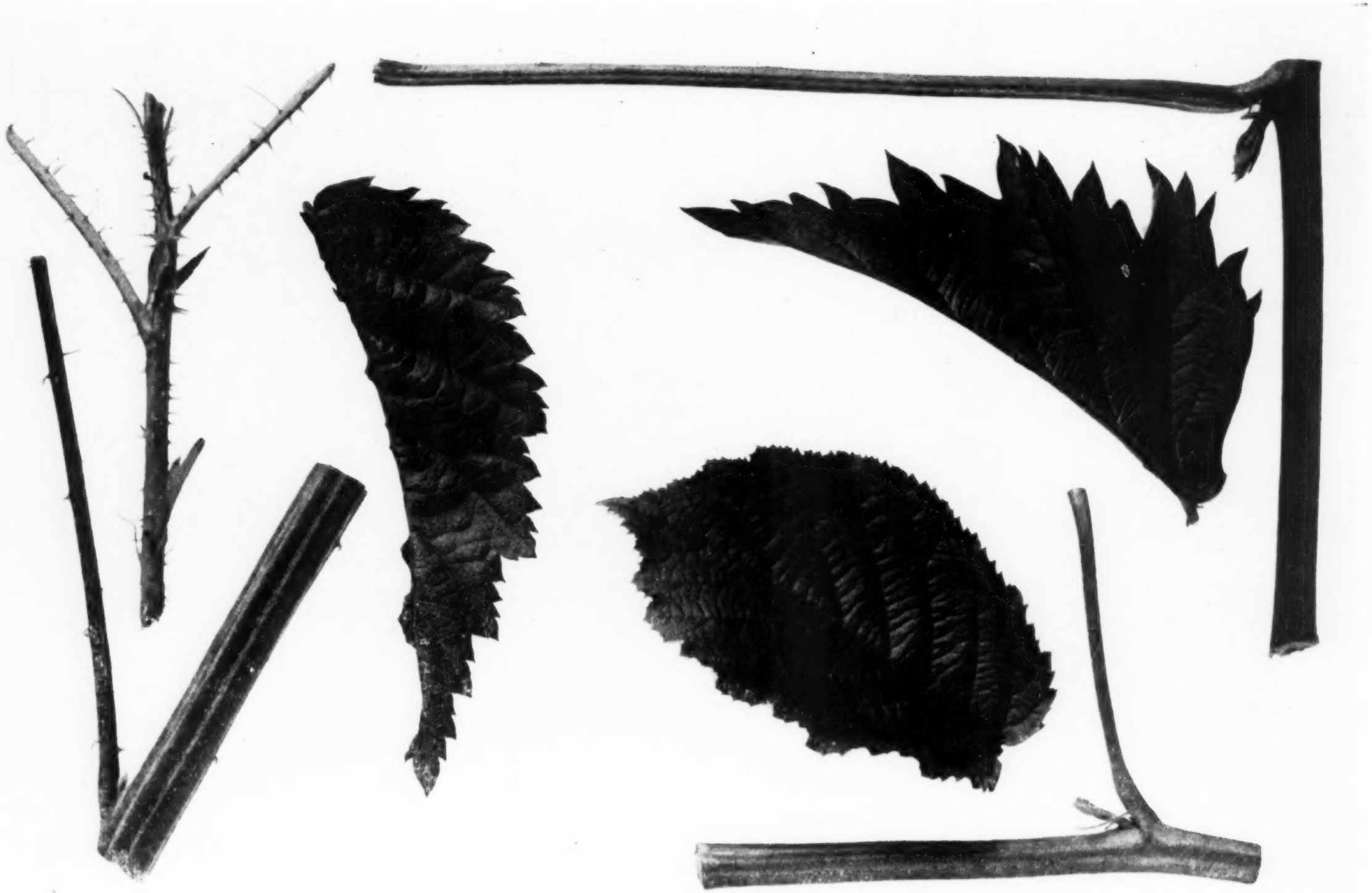
Some nurserymen have unknowingly sold the Burbank Thornless variety for the Cory and this has led to considerable complaint about the non-productivity of the Cory. The true Cory is an excellent bearer when grown from well rooted, vigorous tips. The first propagations were grown in hills 8 feet by 9 feet and bore at the rate of twelve pounds of berries per hill every third day at the height of the season.

(Above account based on oral record as reported by J. D. Cory in June, 1927, to H. M. Butterfield).

The Austin Thornless Dewberry

According to records supplied by Geo. M. Darrow of the United States Department of Agriculture this thornless dewberry was found on the place of Mrs. S. M. Austin, east of Gainesville, Texas. It was first actually fruited in May, 1912, by W. P. Austin, Gainesville, Texas and the name published in 1917. While the variety was supposed to be a chance seedling of the Austin, being first noticed in a row of this dewberry variety, it may be a thornless sport from the root of an Austin (Mayes) dewberry. It reproduces true to type and plants grown from root cuttings are entirely thornless. Very vigorous canes from the base of a plant may have prickles when young but these soon disappear.

The variety has been widely grown in the southern states and in the spring of 1924 was brought to Califfornia by the author. In 1925, Preston and



LEAVES AND STEMS OF THORNLESS BLACKBERRIES

Figure 10

At left, stems and leaf of Cory thornless. The stem with thorns is from a root sucker and these are usually thorny. At right, above, leaf and stem of the thornless Austin; below, of Burbank Thornless. Note rounder leaf and smaller serrations of the latter.

FLOWERS OF THORNLESS VARIETIES

Figure 11

At left, slightly pink flower of Burbank Thornless; at right, above, flower of Austin Thornless Dewberry; below, of Cory Thornless Blackberry.

Knott, large berry growers of Orange County, California tested it and since then others have grown and listed this dewberry.

Burbank Thornless

The late Luther Burbank of Santa Rosa, Calif., sent out for trial several thornless berry seedlings. W. A. Hyde of Watsonville, tried out about six of the seedlings but pronounced all as having no commercial value. Mr. Burbank named two of the seedlings the Santa Rosa and the Sebastopol, but nurserymen now group all of the seedlings under the common name, Burbank Thornless. Most of the seedlings are very slow to come into bearing and all seem to be rather poor in quality.

The exact origin of the Burbank Thornless is doubtful but it may have been derived from *Rubus ulmifolius*, Schott, var *inermis*, Foche of Europe. There are also similar thornless wild blackberries reported near Bagdad. Characteristics of the Burbank Thornless indicate its possible relationship to these forms.

Other Seedling Thornless Blackberries

H. Ness in his work with berries (See *Texas Bulletin 326*) had a race of seedlings from the MacDonald variety of blackberry that gave about 50 per cent thornless plants in each generation. Professor Ness classified these as Spineless Erect and Spineless Diffuse, according to the habit of growth. None of them had any particular merit and were finally discarded when Professor Ness discontinued his breeding work with berries.

The writer crossed the Cory Thornless blackberry with the Thornless Austin dewberry and secured seedlings in 1926 which averaged about 25 per cent thornless. These thornless seedlings look more like the pollen parent, the Thornless Austin, and have a very similar habit of growth. Most of these thornless seedlings are covered with a pubescence like the Thornless Austin, yet at least one is practically free of the hairy covering on either side of the leaves. Some of the seedlings seem to have leaves more like the Cory Thornless than the Thornless Austin. None fruited in 1927.

THE THORNLESS MOUNTAIN BLACKBERRY

Figure 12

Although *Rubus Canadensis* has long been known in the wild, no varieties of this species are in general cultivation. Its fruit is medium in size and high flavored, while the plant is probably much hardier than that of cultivated varieties which are derived from tenderer forms. It would seem promising for use in breeding.

NOTES ON THORNLESS BLACKBERRIES

Their Chromosome Number and their Breeding

By Geo. M. Darrow

ALL who have picked either wild or cultivated blackberries or who have come to grief from unexpected contact with them have an abiding and heartfelt interest in thornless sorts. H. M. Butterfield, in the accompanying article, has called attention to the three thornless varieties in the trade at the present time. Some additional points are given below which may possibly be of interest in this connection.

The evidence given by Mr. Butterfield indicates that the Cory Thornless originated as a bud sport of the Mammoth. It is, however, apparently a "chimera" with the sport tissue overlaying that of the thorny. When grown from root cuttings the buds which form the shoot develop only from inner tissue. Occasionally also branches of the top revert to the thorny Mammoth, that is, the bud is formed from the underlying tissue rather than from the outer thornless tissue (Figure 13). The Cory and Mammoth varieties are adapted only to the Pacific Coast regions. The Cory has been extensively tested in eastern States but the young canes usually are killed back to the ground each year. Under such conditions new shoots often appear from below the ground-level and are thorny.

The Austin Thornless may also be a sport but, if so, it is not a "chimera" as is the Cory. When grown from root cuttings it is never thorny.

The third variety, Burbank Thornless, is undoubtedly a seedling of a thornless garden form, a native of Europe. The forms of this tested by the United States Department of Agriculture have been self-sterile as has also the Cory Thornless. Though the Burbank Thornless has been of no value for its fruit it may be of considerable value as a ground cover in southern States. Its leaves are partly evergreen at Washington, D. C. and its dark green healthy foliage and abundant pink flowers make it very attractive.

All of the few hybrids raised by the writer, (about 10 in number), of Burbank Thornless with Oregon Evergreen, a related European variety, have been sterile (Figure 14) although two hybrids of Oregon Evergreen with Himalaya, the latter also being of European origin, have been quite fertile. Explanation of this behavior has been furnished me by A. E. Longley who has found that the Oregon Evergreen and Himalaya belong to the 14-chromosome group of Rubi while Burbank Thornless belongs to the 7-chromosome group. In this case, as in the case of many crop plants, inter-group sterility apparently occurs. Longley has found the chromosome number of the Austin Thornless to be 28 which lead one to expect more or less difficulty in breeding it with the Burbank Thornless.

Besides these thornless varieties there is a thornless blackberry species (*Rubus canadensis*) which is indigenous to eastern North America (Figure 12). It has been collected by the writer in northern Georgia (Tallulah Falls), Wisconsin, Massachusetts, Vermont, and Maine. Except for the Tallulah Falls station it is apparently native to the higher mountains only, in its southern range, but in Maine it may be found in the lowlands. Its fruit is of only medium size but is of good flavor. It is often found with more or less prickles on the canes, a condition thought to be due to past contamination with other species. Several introductions of varieties have apparently been made but none has been successful. Near farm houses in Maine the writer has seen patches of

MUTATION IN CORY BLACKBERRY

Figure 13

A thorny branch from a shoot of the Cory Thornless blackberry. The branch is probably pure Mammoth tissue while the shoot is a chimera with thornless tissue overlying tissue of the thorny Mammoth. Photo by C. A. Reed.

A HYBRID BETWEEN THORNLESS VARIETIES

Figure 14

A completely sterile hybrid of Burbank Thornless×Oregon Evergreen blackberries. All seedlings from this cross have been both sterile and thorny. The Oregon Evergreen has 14 chromosomes, the Burbank, 7.

THORNLESS SPORT OF HIMALAYA

Figure 15

Propagation of an almost thornless shoot of the Himalaya blackberry. This propagation, however, resembles in some ways plants affected with a virus disease and it is barely possible that such a disease might so affect the plant as to hinder the formation of thorns.

this species which were prized for their fruit but were not cultivated. Longley has studied this species, and the forms examined by him had a chromosome number of 21/2, a number usually associated with a first generation hybrid. Brainerd and Pietersen† reported that its pollen was 85 per cent imperfect but that its seedlings showed no segregation under culture. Moreover, the species is found in mountain woodlands, even in dense forests, and has been commonly considered as a basic species belonging to the semi-erect group of eastern North American blackberries. It is difficult to reconcile its peculiar chromosome number and imperfect pollen with its standing as a basic species. A satisfactory understanding of the utility of this species for breeding apparently most await actual breeding tests. In its typical form it seems to be a shade-loving cool-climate species and does not succeed generally under cultivation. It has fruited sparingly in the United States Department of Agriculture plantation near Washington, D. C.

In 1926 propagations of an almost thornless sport of the Himalaya blackberry were seen in Oregon. Certain branches on the parent plant were nearly thornless and, when rooted at the tip produced nearly thornless plants. The leaves of the sport were, however, somewhat wrinkled and suggested a virus disease infection. (Figure 15).

In 1916 thornless shoots were seen on a plant of the Oregon Evergreen at Puyallup, Wash., but as far as is known this has not been propagated.

All these thornless forms need careful study in the hope of finding among them a type of special value, or of producing through breeding with them varieties as valuable for general culture as are the Cory Thornless and the Thornless Austin in the regions to which they are adapted.

†Brainerd, Ezra and A. K. Peitersen. Blackberries of New England: Their Classification. *Vt. Agr. Exp. Sta. Bul.* 217, 84, illus.